Tax Responsiveness of the Self-Employed

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Preface

The thesis is written as a completion of the Master of Economic Theory and Econometrics at the University of Oslo. I have learned a great deal from writing the thesis, and some people deserves a special thank for that. It could not have been written without the aid of my supervisor, Thor Olav Thoresen, whose direct advice and helpful suggestions have been crucial in the process.

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Summary

While considerable evidence exists on tax responses for wage earners, less is known about the self-employed. As they play an important role in the economy and can respond to taxation in multiple ways, more information on this group is needed. To give insight into this multifaceted issue, I first survey literature on tax-induced changes in taxable income, working hours, capital, avoidance and evasion, entry and exit, and organisational form. Then, I investigate the tax responsiveness of the Norwegian self-employed empirically. Two key responses, the elasticity of taxable income (ETI) and the elasticity of working hours, are measured using information from two data sets, the *Income Statistics for Families and Persons* and the *Labour Force Survey*. By applying quasi-experimental techniques on these data for the period 2001 to 2010 and exploiting the tax variation induced by the 2006 tax reform, I obtain estimates of the two responses. For the estimation of the ETI, panel data analysis along with an instrumental variable approach is employed. In addition, controls for mean reversion and trends in income are added. For the estimation of the elasticity of working hours, a difference-in-differences approach is adopted.

From the empirical analysis, an ETI between 0.19 and 0.22 and an elasticity of working hours between 0.13 and 0.19 are found. The estimates indicate that the self-employed responded to the tax reform by earning more income and working more hours than they otherwise would have. These responses are larger than corresponding estimates for wage earners in Norway, but imply only low efficiency losses from income taxation of the self-employed. The difference between the ETI and the elasticity of working hours is seen as a "residual" effect, which include different tax responses. Under certain conditions, the elasticity of working hours can be interpreted as an estimate of the "real" effect part of the ETI, while the residual effect can be interpreted as an "elasticity of sheltering", ranging from -0.06 to -0.03. This indicates that income sheltering (evasion and avoidance) is reduced as a result of the tax reform. However, the magnitude of the sheltering response suggests that the amount of income sheltered from taxation is small or that it does not respond much to tax changes. Hence, the evidence points to that the self-employed are responsive to tax changes, although not to a large extent, and that they respond more by adjusting working hours than sheltered income.

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1. Introduction

Information about tax responses is important in order to develop an efficient tax system. The size of a tax response can be a crucial argument in the choice of tax rates for different groups, and hence can have large impact on the design of the tax schedule. Mirrlees' analysis of optimal taxation was an influential starting point for research into what effects must be identified to compute optimal tax levels (Mirrlees, 1971). It makes clear that welfare effects of taxation depend critically on how tax changes affect the behaviour of individuals and firms. Information about behavioural effects of taxation is therefore crucial from a public policy perspective.

After Lindsey (1987) and Feldstein (1995) it has become widespread to obtain estimates of tax induced responses in income by analysing panel data over a tax reform period, exploiting the variation in tax treatment across individuals generated by tax reforms. The main focus has been on the elasticity of taxable income (ETI), which is a crude overall measure of the responses to tax changes. It is meant to capture the total effect of a tax change and to be used in welfare analysis of tax reforms (Feldstein, 1995; 1999). Both Lindsey and Feldstein found large elasticities. A large ETI can be a sign of high efficiency costs of taxation and can therefore be an argument for lowering tax levels. Some of Lindsey's and Feldstein's estimates indicated that the tax rate was on the right hand side of the top of the Laffer curve, meaning that revenues could be increased by reducing the tax rate. These articles sparked a substantial, and still ongoing, research wave into the elasticity of taxable income. Econometric developments for estimating the ETI have applied new methods to address empirical challenges in the identification in panel data. The estimated elasticities in post Feldstein studies have been markedly lower; see for example Auten and Carrol (1999), Aarbu and Thoresen (2001), Gruber and Saez (2002) and Giertz (2007). If these estimates are closer to the actual efficiency cost of taxation, the earlier arguments for lowering tax levels need not hold.

For Norway, tax responses have been estimated with the ETI framework by Aarbu and Thoresen (2001), where a low elasticity is found on a pooled sample of wage earners and self-employed. The ETI framework is also used by Thoresen and Vattø (2013), where the variation according to the 2006-reform is exploited to validate a structural model of labour supply. Similarly, their estimated elasticities suggest small responses for wage earners.

Although sparse compared to evidence for wage earners, some research has been done using the ETI framework on tax responses for the self-employed, such as Heim (2010). He estimates the ETI for the self-employed in the US, and finds relatively large elasticities for this group. The real effect share of the ETI is deduced by findings from other articles on the relative share of tax evasion, and is then

found to be much smaller than the "full ETI". Kleven and Schultz (2014) estimate the ETI for both wage earners and self-employed separately, and find larger responses to taxation in the latter group, although still in the low-response part of the literature.

There are additional interpretational challenges when addressing behaviour of the self-employed compared to wage earners. In spite of the possibility that all responses to taxation are included in the ETI, distinguishing between different responses can be of importance, particularly for the self-employed. For example, if there is income shifting between bases it will generally not be sufficient to only use the ETI for welfare analysis of tax reforms, and information about the different margins will be necessary (Gordon and Slemrod, 2000). Furthermore, insights into the multiple behavioural responses are important, not only to increase the understanding of behaviour, but also because there may be different policies applicable to different responses. The real response share of the ETI can be of particular interest for the self-employed, as it can be more informative for policy than the full ETI.

The present analysis is the first study of the tax behaviour of the self-employed in Norway using the ETI framework. I estimate the ETI for the self-employed in Norway. In addition, I provide separate evidence on the hours of work response. The ETI is estimated on register income data for Norway (Statistics Norway, 2005) while data for hours of work is obtained from the Labour Force Survey (Statistics Norway, 2003). The ETI and the hours of work elasticity are compared to separate responses into real effects and other effects. I apply quasi-experimental techniques, using data for 2001 to 2010, and exploiting that the 2006 tax reform generates tax variation to identify the ETI and the hours of work elasticity. The variation induced by the tax reform implies that different groups of self-employed taxpayers experience different changes in tax treatment, and hence there will be exogenous variation in the data which can be used to identify the effects. For the income data, I use panel data methods in combination with an instrumental variable approach. The instrument is needed to account for the endogeneity problem between income and marginal tax rates. In addition, there are problems with mean reversion and exogenous trends in income, and methods to account for this will be applied. For the working hours estimation, due to the repeated cross section nature of the data, I will use a standard difference-in-differences method to obtain an estimate of the elasticity of working hours. The thesis could be policy relevant, both as a partial evaluation of the 2006 tax reform in Norway and as information about the tax responses of self-employed. In addition, these estimates can potentially be used to validate structural models for exploring the effects of tax changes, in a similar way as in Thoresen and Vattø (2007).

The self-employed represent a challenge by being subject to multiple possible definitions, ranging from self-reported self-employment status to sole proprietors and definitions based on income shares. Whichever definition is applied, the self-employed are an important part of most economies. While the number of self-employed in developing countries is generally higher, there are substantial amounts of self-employment also in developed countries. However, Norway seems to have a lower degree of self-employment than other OECD-countries (Parker, 2006). When earning business income is used as the definition of self-employment, there were 333,656 self-employed in Norway in 2013 (Statistics Norway, 2014). Furthermore, the self-employed are a diverse group. They consist of independent professionals (dentists, lawyers and so on), farmers, creative workers, craftsmen, owners of small shops and grocery stores, and subcontractors and so on. The diversity means that there could be great heterogeneity in responses to taxation, as possibilities for evasion, avoidance, time shifting and base shifting may differ widely between these groups. This large heterogeneity represents a challenge when measuring tax responses.

An important aspect when measuring behaviour of the self-employed is their greater possibilities to reduce tax burden by changing working hours, shifting income across bases and time, and avoiding or evading taxation. These wider possibilities for behavioural responses to taxation make the self-employed particularly interesting from a tax research point of view. However, it does also complicate the analysis. The wider scope for the self-employed comes in different forms, and may give considerable interpretational problems when discussing effects of tax changes. Firstly, it is almost impossible to distinguish between returns to capital and returns to labour for the self-employed. When tax changes affect the use of capital in the firm, the consequence is a potential identification problem in the empirical analysis, as the effect on capital and labour cannot be separated. This stems from the fact that in many cases it is hard to draw a line between the self-employed person and the firm. As some of the income is derived from capital and some from work efforts, the tax system may split the two in some way, giving different incentives for capital and labour efforts. Secondly, tax evasion and avoidance lead to differences between reported income and actual income. These responses may create a disparity between real effects and total effects. Thirdly, the self-employed may respond to tax changes by shifting organisational form, which also complicates empirical research.

Taxation of the self-employed has been of particular concern in the design of the Norwegian dual income tax. From 1992, income was split into capital and labour, assigning a flat and low tax rate on capital income and an additional progressive tax rate on labour income. With the revision of the dual income tax in the 2006 tax reform, a more equal treatment of the self-employed and other

organisational forms was introduced, mainly because of tax-payers avoiding the split model. The tax reform did also lower surtax rates, which is the central variation used for identification here.

The thesis will proceed as follows: The next section introduces the main theoretical concepts used in the thesis. Here the emphasis will be on the ETI and the elasticity of hours work. Four additional responses will be introduced. The third section surveys literature on tax induced behaviour of the self-employed. The fourth section will explain the main tax changes introduced by the 2006 tax reform, the data used in estimating the responses and the specifications used in these estimations. The fifth section will present the results. Finally, the last section summarizes the main findings and concludes.

2. Concepts in Self-Employed's Responses to Taxation

In this section, some tax response concepts are introduced. The key concepts are the elasticity of taxable income (ETI) and the elasticity of hours, but also capital responses, avoidance and evasion, entry and exit, and organisational shifts will be discussed. The ETI and the elasticity of hours are of particular importance for this study, as they are the two responses that will be measured.

Each of these tax responses can be characterized as real or shifting and sheltering. Real responses are typically changes in working hours, effort, savings and investment. Shifting and sheltering responses are for instance income shifting across time or base and changes in evasion and avoidance. Slemrod (1992) suggests a way to classify tax responses according to their responsiveness. His behavioural hierarchy postulates that timing effects are the top of the hierarchy. There can be large incentives to realize or delay gains before a tax reform takes place. Income that is easily delayed or forwarded can react strongly to such tax reforms. At the next step in the hierarchy is shifting between bases and evasion or avoidance. Lastly, at the bottom of the hierarchy, are real responses.

2.1 Elasticity of taxable income

This section will present the underlying behavioural model leading to the ETI in a framework for the self-employed. Some central properties and issues concerning the ETI will also be discussed. The exposition is inspired by Saez et al (2012).

To present the ETI in a setting fit for the self-employed, it is assumed that the self-employed have one firm each, where their labour is the only input in production and has constant returns to scale. This does not mean that the self-employed do not use capital in their production, but that I assume the use of capital to be fixed, which can be interpreted as a short-term model of responses to taxation. The constant returns to scale assumption can be understood as a linear approximation around a small change in the hours worked. In addition, the price on the consumption good are normalised to one, and the self-employed are assumed to produce this kind of consumption good.

Then the firm's production function will be

$$x = f(h), \tag{2.1}$$

which, by constant returns to scale, will equal

$$f(h) = f'(h)h = wh\,. \tag{2.2}$$

The marginal productivity of labour in the self-employed's business will be called self-employed wage, w.

The self-employed are assumed to have a utility function described by

$$u = u(c, z)\,, \tag{2.3}$$

which depends positively on consumption, c, but negatively on reported or taxable income, z, defined as

$$z = wh - s\,, \tag{2.4}$$

where h is hours of work and s is income sheltered (by legal or illegal means). Introducing dependence on reported income makes it possible to incorporate other behavioural margins than labour supply. The negative effect of reported income can be interpreted as costly efforts to obtain income. If effort increases, utility falls. However, by increasing effort, reported income increases and this relaxes the budget constraint. Efforts can include both the utility cost of working hours or of sheltering income.

Each self-employed individual will then maximize utility subject to the budget constraint

$$\max_{c,z} \{u(c, z)\} \quad s.t.\ c \leq (1 - \tau)z + s + E\,, \tag{2.5}$$

where τ is the marginal tax rate and E is non-labour income. The maximization leads to

$$z = z(1 - \tau, E)\,, \tag{2.6}$$

which means that taxable income is implicitly defined as a function of the marginal tax rate and non-labour income. Now, as taxable income is chosen for each individual self-employed for a given marginal tax level, the elasticity of taxable income is

$$e_{ETI} = \frac{1 - \tau}{z} \frac{\partial z}{\partial (1 - \tau)}\,, \tag{2.7}$$

where τ is the marginal tax rate and z is taxable income. It is the percent change in taxable income by increasing the net-of-tax rate by one percent. The ETI can, under certain conditions, be interpreted as an overall measure of the responses to tax changes.

Feldstein (1999) showed that the marginal welfare loss from raising the income tax rate can be expressed purely as a function of the ETI, which means that it has the potential for being a sufficient statistic. This conveys that on the margin the ETI incorporates all responses to taxation in a correct manner for welfare analysis. The reason is that the opportunity costs of reducing taxable income will in equilibrium be equalised for all types of responses. Given that that the private and social costs of sheltering one krone of income are the same for all types of behavioural responses, the elasticity of taxable income will a sufficient statistic (Slemrod and Gilitzer, 2014). The formal arguments for this are presented and derived in Appendix A.1.

Saez et al (2012) however, argue that the ETI, the way it is derived, depends on the tax system and on the particular reform, and is therefore not a "deep" structural parameter. Moreover, if the social and private costs of reduced taxable income are different, the change in welfare will not equal the ETI. This can happen if evading taxes induces other to evade taxes, because then the social costs of tax evasion are larger than the private costs, or if taxable income is sheltered by giving money to charity (Chetty, 2009). A point emphasized by Harju and Matikka (2014) is that the ETI will not incorporate all welfare effects on the margin if there are different tax rates at different tax bases, and some of the change in taxable income is income being moved to another tax base.

Heim (Heim, 2010) distinguishes between three main types of tax responses for the self-employed: a real effect, a reporting effect and a base effect. The real effect consists mainly of changes in working hours and work effort. The reporting effect is the change in reporting income caused by the tax reform. The base effect is the change in which base the income is reported induced by the reform. Together these three main types of effects constitute the ETI.

Given the framework set up here, ETI can be partioned into an hours worked elasticity and a "sheltering elasticity"

$$e_{ETI} = \frac{1-\tau}{z}\frac{\partial z}{\partial(1-\tau)} = \frac{1-\tau}{z}\frac{\partial(wh-s)}{\partial(1-\tau)} \tag{2.8}$$

$$= w\frac{1-\tau}{z}\frac{\partial h}{\partial(1-\tau)} - \frac{1-\tau}{z}\frac{\partial s}{\partial(1-\tau)}. \tag{2.9}$$

The first part relates to the hours worked and the latter part to the sheltering. The elasticity of sheltering responses, which often is unobserved, can then be seen as

$$Elasticity\ of\ sheltering = Elasticity\ of\ hours - ETI\ . \tag{2.10}$$

Hence, if sheltering is decreasing in the net-of-tax rate, meaning that the elasticity of sheltering is negative, the ETI will be larger than the elasticity of hours. The relationship will be investigated in the empirical part of the thesis.

If sheltering decreases when the net-of-tax rate increases, the efficiency loss of increasing taxes is higher than it otherwise would have been. This effect comes from the fact that the self-employed incur costs by sheltering, and that these costs are reduced when sheltering is reduced. For the welfare assessment of tax changes based on the ETI to be correct, a crucial assumption is that the private costs of sheltering and reducing hours of work equal the social costs of the two. As this assumption need not hold, for example if part of what is sheltered also is taxed but at a lower tax rate, then the efficiency loss of reduced labour supply is higher than of increased sheltering. The size of the two elasticities constituting the ETI, working hours and sheltering, is then of interest to policy makers when designing the tax schedule. Furthermore, different policy measures may be effective for different responses. If sheltering can be reduced more effectively by increasing penalties for tax evasion, understanding the size of sheltering can be of direct policy relevance. In addition, a decomposition of different behavioural responses can provide a better understanding of responses to taxation. Therefore, this thesis will now turn to the anatomy of tax responses.

2.2 Elasticity of working hours

Now, the same framework used for income can be applied to working hours as well. To emphasize the choice of hours and to derive the hours of work elasticity, income sheltering is ignored here.

Let a self-employed's utility now be characterized as

$$u = u(c, l)\ , \tag{2.11}$$

where c is consumption and l is leisure. I assume that $u'_c > 0$ and $u'_l > 0$, and I abstract from intertemporal considerations in this theoretical set up.

The budget constraint is then given by

$$c \leq (1-\tau)wh + E\,, \tag{2.12}$$

which will hold with equality as utility is strictly increasing in c. τ is the marginal tax rate, h is hours worked, w is the wage rate and E is non-labour income, for example transfers.

The time constraint is given by

$$T = l + h\,, \tag{2.13}$$

where T is total time.

Assuming the self-employed is a utility maximizer

$$\max_{c,l}\{u(c,l)\} \quad s.t. \;\; c = (1-\tau)wh + E \;\; and \;\; T = l + h \tag{2.14}$$

which is equivalent to

$$\max_{h}\big\{u\big((1-\tau)wh + E, T - h\big)\big\}\,. \tag{2.15}$$

Thus, by the first order condition we have

$$\frac{u_c'}{u_l'} = (1-\tau)w\,, \tag{2.16}$$

which with the budget constraint implicitly determines hours worked and consumption jointly for the self-employed. I is defined as full income, which is the monetary value of the time available plus non-labour income,

$$I = (1-\tau)wT + E\,. \tag{2.17}$$

Hence,

$$h = h(w, \tau, I)\,. \tag{2.18}$$

Increasing the marginal tax rate has a direct effect and an effect through full income. This is the substitution and income effect

$$\frac{dh}{d\tau} = \frac{\partial h}{\partial \tau} + \frac{\partial h}{\partial I}\frac{\partial I}{\partial \tau} = \frac{\partial h}{\partial \tau} - wT\frac{\partial h}{\partial I}\,. \tag{2.19}$$

An increase in the tax rate has an ambiguous effect on the hours worked of the agent, as the income and substitution effect go different ways. The substitution effect will be negative, because, as leisure becomes cheaper when the marginal tax rate rises, fewer hours will be worked. The income effect is positive, as increased tax reduces income, which reduces the demand for all goods, including leisure. It is often assumed that the substitution effect is larger than the income effect, but this is an empirical question.

Now, the elasticity is the percent change in hours worked when the marginal net of tax rate increases by one percent

$$e_H = \frac{1-\tau}{h}\frac{\partial h}{\partial(1-\tau)}. \tag{2.20}$$

This elasticity will be estimated for the self-employed in the empirical part. The elasticity has to be multiplied by $\frac{wh}{z}$, where z is taxable income, to transfer it to the working hours effect on reported income, which is needed to be compare it to the ETI

$$e_{HI} = w\frac{1-\tau}{z}\frac{\partial h}{\partial(1-\tau)}. \tag{2.21}$$

If the ETI and the elasticity of hours are not equal, there will be a "residual" effect, which can include capital responses, changes in evasion or avoidance, changes in effort and in principle all other income-generating behaviour responses that are not hours of work. These effects can go in opposite directions, meaning that the ETI can be both larger and smaller than the elasticity of hours. Given the framework set up in Section 2.1, this residual can be given the interpretation of a "sheltering elasticity". This rests on the assumption that all other income-generating behaviour is either not responding to tax changes or does not respond in the short term. The "residual" effect may also include other types of responses, and some of these will now be discussed.

2.3 Capital responses

The measurement of tax responses for the self-employed is further complicated by this group of tax-payers being responsive to changes in the taxation of capital. Changes to marginal tax rates on income can affect the amount of capital used in the self-employed's firms. When there is a separate tax rate on labour and capital, changes to both tax rates may have an impact. A lower marginal tax rate on capital will increase the incentive to invest in capital relatively to labour efforts. In addition, the profitability of the firm will be higher, further increasing the incentives to invest in capital. If

marginal tax rates on labour are reduced, this can induce the self-employed to use less capital in their firm by a substitution effect, because their labour efforts will then have a higher net return compared to capital than before. However, the income effect of lower marginal tax rates may induce the self-employed to expand, and by that invest in more capital. This renders the net effect of labour income tax changes on capital use undecidable by theory. There can be great heterogeneity in responses, as self-employed in different sectors will have very different capital intensities and possibilities for changing their capital use.

Capital responses can potentially be a part of the ETI, as a change in the amount of capital used in the firm will affect taxable income, just as changes in working hours do. Capital responses possibly take longer time than other behavioural responses, and may not represent a large share given the three years responses often used in the ETI literature, but could be an important part of long term elasticities for self-employed in capital incentive sectors. Capital investment is also an important mean for moving income across time. If tax rates are going to be reduced in the near future, the self-employed might decide to invest now to reduce profits in this period, and then increase profits when the tax rates are lower. Because of the close relationship between the self-employed individual and the firm, it is almost impossible to distinguish between income derived from capital and income derived from labour effort, even though the dual income tax system of Norway included a procedure to do so. As income derived from capital is not clearly defined for the self-employed, it is difficult to identify capital responses.

2.4 Avoidance and evasion

Further, tax avoidance and evasion affect the total response to taxation. Avoidance is here defined as legal measures to avoid taxation, while evasion is defined as illegal measures. Avoidance can take many forms, for example by transferring income from the business owner to the spouse or buying inventory for the firm that is also used for personal purposes. Evasion can be direct underreporting of income, over-reporting of business expenditures, and so on. The “sheltering response” measured in the thesis include both tax evasion and avoidance responses.

One of the first attempts to theoretically model tax evasion was done by Allingham and Sandmo (1972). They laid important foundations into the relation between risk aversion and fraction of income declared. Their model implies that there is both a substitution and income effect of increasing taxation on tax evasion. The substitution effect is that higher tax rates increases the incentive to evade because the gain of doing so is larger. The income effect is that a higher tax rate will decrease income, which again can decrease the willingness to take risks if risk-aversion is

decreasing in income. Therefore, depending on risk-aversion, increased taxation can either increase or decrease tax evasion. As their theoretical investigation gave no clear conclusion on the sign of the response, empirical work was needed to gain more knowledge on the relation between taxation and evasion.

Evasion and avoidance can be responses that are substitutes for real responses. If the self-employed can respond to higher taxation by evading more, instead of working less, there will be smaller real responses than if there were no possibilities for evasion (Slemrod, 2002). Therefore, labour supply responses as a measure of real responses might be biased downward when there are significant amounts of tax evasion and this is a substitute for real responses.

2.5 Entry and exit

An important behavioural response to taxation is selection in and out of self-employment. If either employees or self-employed have a particularly favourable tax treatment, this may induce people to change from the one to the other. Much of the literature on the self-employed is concerned about this extensive margin. There are models for entry and exit into self-employment, and how this relates to the tax rate (Bruce, 2002). The emphasis on entry and exit can be understood as an interest in the entrepreneurial side of the economy. More self-employed may be related to more entrepreneurial activity, although the link between self-employment and entrepreneurship is disputed (Parker, 2006).

With risk-averse agents choosing between wage and self-employment income, there is an ambiguity in the sign of the effect of taxation on the choice of being self-employed (Bruce, 2002). One way to explore this, as is done in Bruce (2002) and Paul and Bechtold (2015), is to have a model where self-employment income will differ if the self-employed is successful or unsuccessful. The uncertainty in the gains of self-employment has important consequences. From this, one potential relation between self-employment and tax rates is that a higher tax rate decreases self-employment, through that less of the gains if successful is accrued to the self-employed. However, depending on the risk aversion, another possibility is that high tax rates might function as a kind of insurance against bad outcomes. This can lead to the tax rates having a positive effect on self-employment. In addition, high tax levels might make the possibility for evading taxes more valuable, which could also increase the incentives for being self-employed. Because the total effect of tax levels on the choice of being self-employed is ambiguous, empirical evidence on this is necessary.

Both the marginal tax rate and the average tax rate might influence the decision about self-employment. Which tax rate is the appropriate depends on whether the decision about being self-

employed is a one-off decision or a decision about whether the next earned krone will be in self-employment or wage. For the former case, the average tax rate is the appropriate variable of interest, for the latter case it is the marginal tax rate.

2.6 Organisational shifts

Another opportunity for the self-employed is to shift income between bases. For the Norwegian self-employed, this can mainly be done by changing organisational form. It is closely related to entry and exit into self-employment, as organisational changes normally will be visible as entries or exits. The organisational shifts can take various forms, depending on the specific system in the country considered. Organisational shifts can have important consequences, as it changes the group that remains self-employed. This is important because organisational shifting changes the sample used for estimation and the shifting may be related to the marginal tax levels, income and working hours.

3. Survey of Self-Employed's Responses to Taxation

In this section, I will present some empirical evidence on the different margins discussed in Section 2.

3.1 ETI for the self-employed

A few studies have used the ETI methodology to study the behavioural responses of the self-employed. Blow and Preston (2002) use the methodology to estimate the ETI and emphasize the self-employed's potential for exemptions, as well as avoidance and evasion. As they do not have panel data available, they use a grouping estimator on repeated cross-section survey data. Their conclusion is that the taxation of self-employed is associated with a moderate deadweight loss.

Heim (2010) estimates the elasticity of taxable income for the self-employed in the U.S. Panel data analysis is used and the data covers the years from 1987 to 1996. The paper aims to aggregate the real, reporting and base effect to an overall measure, which is the elasticity of taxable income. By doing this, an overall elasticity is estimated to be around 0.9, with a real elasticity counterpart of 0.4. The former estimate is considerably higher than most estimates of the ETI for wage earners. The endogeneity of the marginal tax rate is accounted for by instrumenting the change in tax rates by the tax rate the individual would have faced three years later if the income in the base year was inflated three years forward. Two particular issues to the panel data analysis, mean reversion and exogenous trends in income, are addressed in Heim's paper. Firstly, they are tackled by adding a ten piece spline in the base year income, and secondly, by adding ten piece splines in the log of lagged income and in the deviation of log of lagged income from base year log income. Adding these controls affects the results to a large extent, and reduces the estimated elasticity.

To obtain a real elasticity, net of underreporting, Heim uses estimates from two other papers to do a calculation of the share of non-reported business income. Hence, Heim's real elasticity includes both the real effect and the base shifting effect, which is the effect of shifting taxes between the corporate sector and the personal. In the robustness check, the base shifting effect is controlled for by doing some sample restrictions, which should reduce the importance of shifting. By doing this, the estimated elasticity increases, but is not significantly different from the main estimate. Income shifting across years is controlled for by estimating the shifting forward and shifting backward elasticities. Controlling for this changes the elasticity slightly, to just above 1. At last, Heim distinguishes between two explanations of the higher elasticity for the self-employed. The first possibility is that more tax responsive individuals select into self-employment, while the second is

that self-employment income is easier changed. Heim finds support for the second explanation by estimating the elasticity of wages for the self-employed, which is found to be low.

Kleven and Schultz (2014) estimate the ETI for both wage earners and the self-employed on Danish data. Both the elasticity of labour income and the total elasticity of taxable income are found to be about twice as large for the self-employed compared to the wage earners. However, both are relatively small. They find that as the net of tax rate increases by one percent, the taxable income increases by about 0.10 percent. Their estimates are robust to different specifications and definitions of income. This is a much lower estimate than Heim (2010) finds for the U.S.; see explanation in Kleven and Schultz (2014).

Harju and Matikka (2014) investigate the ETI on Finnish data and find business income to be much more responsive than wage income. In addition, they present evidence for substantial income shifting among business owners, including the self-employed, which leads the real effect part of the ETI to be substantially smaller than the "full ETI".

Identification of tax effects by studying bunching around kink points is also used to assess responsiveness of the self-employed; see e.g. Saez (2010) and Chetty et al (2011) for explanations of the method. It is closely related to the regression discontinuity approach. While in regression discontinuity a cut off induces that it is close to random whether people are on one side or on the other side of the cut off, bunching uses the opposite fact. People would be continuously spread around different marginal tax rates if they were not bunching at kink points. This "excess mass" under the kink point can be used to estimate the total response to change in marginal tax rates, the ETI. One caveat with the approach is that the ETI is only estimated for those that bunch and not as a weighted average of responses over the whole tax schedule. Although the usual ETI estimates also are local in the sense that they are only estimated for those who are moved by the instrument, the bunching method induces a different and further locality. In that sense, the bunching method is a particularly local estimate of tax responses. An important finding in the bunching literature is that it is mainly the self-employed who bunch. Hence, there has been a particular emphasis on the self-employed in recent articles using the bunching method.

Le Maire and Scherning (2013) apply this method to the Danish self-employed. They find an ETI in the range 0.43 to 0.53, without correcting for income shifting, and when income shifting is corrected for, an ETI of 0.14 to 0.20. Their findings indicate that it is the possibility of retaining earnings that explains the large difference between the uncorrected and corrected ETI. The self-employed are defined as those who have self-employment as their main activity, and they argue that the stricter definition of self-employment used in their analysis explains most of the differences in elasticities

compared to the finding by Kleven and Schultz (2014). Bastani and Selin (2014) apply the method to Swedish data, for both wage earners and self-employed. They do not find any evidence of bunching among wage earners, but find significant bunching among the self-employed. However, the elasticities implied from the bunching among the self-employed are low, ranging from 0.02 to 0.07, depending on how broad the definition of self-employment is set to be. Some aspects of the anatomy of responses for the self-employed is explored, where the focus is on deduction possibilities. Their conclusion is that the tax response of the self-employed is not a real labour supply response, but a result of income shifting across time and base.

3.2 Choice of hours

An early contribution on working hours responses of the self-employed was made by Wales (1973). The main question of interest is whether the self-employed are on the backward bending part of the labour supply curve or not. The fact that hours of work also influence the tax rate is an important endogeneity problem in the empirical analysis. This is tackled by an instrumental variable method. His findings indicate that most of the self-employed are not on the backward bending part, and hence would react to increased taxation by reducing hours of work. Relatively small estimates are found for the elasticity of leisure with respect to the surtax rate, with a mean of 0.07 for those with positive elasticities and a mean of -0.04 for those with negative elasticities. This corresponds to labour supply elasticises of about -0.17 and 0.01, respectively.

Parker et al (2005) argue that wage uncertainty is the main driver of differences in hours supplied by self-employed compared to wage earners. This is a structural approach on panel data, meaning that identification is theory driven. They refute other proposed explanations than wage uncertainty, for example different tastes for leisure or indivisibility in production. Without controlling for wage risk, they find significant negative effect of wage on hours worked for the self-employed, while the effect is positive for employees. When the risk measure is included, the point estimates of the wage effect fall in absolute value and become insignificant. They are however still negative. Risk is estimated to have a positive effect on hours worked for the self-employed, explaining part of the higher number of hours worked for this group. As risk may also be affected by tax changes, this can have important policy consequences.

There are several studies which focus on the effect of wages on working hours for specific groups of self-employed. For example, some studies analyse the labour supply of New York taxi drivers; see Camerer et al (1997), Farber (2005) and Ashenfelter et al (2010). Camerer et al (1997) employ relatively simple methods, and find large negative wage elasticity, which indicates that taxi drivers

work one day at a time and work towards an income target for each day. They use an IV approach to control for measurement error, where each cabdrivers wage is instrumented by the wage distribution of the other cabdrivers on the same day. Their chosen specification yields an estimate close to -1, which is interpreted as no evidence of intertemporal substitution in the short term. The finding is contrasted by Farber (2005), who employ a different measure of the daily wage rate and use a different empirical method. His method is structural, as he estimates a "stopping model" for the taxi drivers. One of the critiques of the Camerer et al paper presented by Farber is that they assume wage to be constant over the day, which is at odds with the evidence provided by Farber. The stopping model gives no significant effect of income earned that day, but a negative effect of hours worked. This is more in line with the theoretical predictions of the neoclassical consumption-leisure model. Ashenfelter et al (2010) use panel data and exogenous changes in the wage rate to obtain estimates of the long run elasticity. This is closer to a quasi-experimental approach, as they do not use model properties to identify the effect, but exogenous variation in the data. They find a significant effect of about -0.2, which they consider as evidence for that the income effect dominates over the substitution effect for the long-run labour supply. Hence the three articles give widely different answers to the labour supply of taxi drivers.

3.3 Capital responses

Carroll et al (2000) investigate the investment decision of the entrepreneur and how it is affected by income taxation. Their definition of an entrepreneur is a sole proprietor, which is also a possible definition of the self-employed. They consider two ways for the tax rate to impact capital investment. Firstly, changes in the tax rate alter the use cost of capital, and hence can affect the investment decision. Secondly, if liquidity constraints are present, a change in the tax rate might affect this constraint. Then, with this in mind, they do a multivariate analysis on data on sole proprietors for 1985 and 1988 to estimate the effects of tax changes on capital investment. The Tax Reform Act of 1986, where high earners were given considerable marginal tax rate reductions, is used to obtain exogenous variation. They conclude that high-income tax rates decreases the probability of making capital investments, and that the effect is rather large. This means that the tax rate can have an important effect on the use of capital for the self-employed.

3.4 Avoidance and evasion

Evidence indicates that the type of income is crucial to whether tax evasion takes place or not, and self-employment income is found to be the type of income that has the largest proportion of evasion; see Feldman and Slemrod (2007) and Slemrod (2007). The self-employed capture a central position in the tax evasion literature as they are sometimes used for identification, under the assumption that they evade, and wage earners do not. The wider scope for avoidance and evasion exist mainly because the self-employed report their own income, while employers report the income of their employees; so-called third party reporting. In addition, the self-employed are often found in sectors where there is person-to-person interaction, which simplifies the act of evading taxes.

There are three main approaches to estimate tax evasion: direct, indirect and model based. The direct method uses information from tax auditing or surveys, the indirect uses different indicators of evasion to estimate the amount, while the model based approach builds a model of the incentives and effects of tax evasion. One popular indirect approach is the Pissarides and Weber approach (Pissarides and Weber, 1989). It consists of comparing the relation between income and food consumption for the self-employed and compare it to similar income groups that are not self-employed. The crucial assumptions are that food consumption is the same for self-employed and employees at similar levels of income and that there is no tax evasion among employees. If there is some underreporting also among employees, this can be a lower bound estimate of tax evasion.

Johansson (2005) apply the Pissarides and Weber approach on Finnish data. He finds the amount of underreported income among households where the head of the household is self-employed to be 16.5 percent. To correct for the possible endogeneity of income, he uses multiple instruments, including house ownership and spouse's labour supply, to obtain a 2SLS estimate. The OLS and 2SLS estimates are not very different. Engström and Holmlund (2009) apply the same method on Swedish data. They use income from capital and property tax as instruments for income, to correct for possible endogeneity and some of the temporality of current income. The estimates are however very similar in the OLS and the IV specification. Their results indicate that the self-employed underreport income by 30 percent. This corresponds to 35 percent of self-employed income among the individuals that underreport. Furthermore, they show that the amount of underreporting is lower among the self-employed that have incorporated business. This means that there potentially can be a cross effect of tax changes on evasion and organisational form, as some organisational forms imply large possibilities for evasion.

Kleven et al (2011) investigate three different aspects of tax evasion using an experiment. The experiment consists of sending threats of auditing to Danish taxpayers by randomization. Their first

finding is that tax evasion is small because those who have a third party report their income evade very little. Those who self-report their income, however, evade to a much larger extent. This is evidence of the larger scope for evasion among the self-employed compared to wage earners. Their second finding is that tax evasion increases when the marginal tax rate increases, which is found by using the bunching method along with their auditing experiment. The findings indicate that the evasion response is small compared to legal avoidance responses and real behaviour responses. Lastly, they find that auditing has a large negative effect on tax evasion. This may point to auditing as a more effective policy towards tax evasion than lowering tax levels, if the costs of audits are not too high compared to the costs of changing the tax schedule.

Kleven and Schultz (2014) argue that their small differences in elasticities for taxable and broad income are evidence for a small degree of tax avoidance and evasion in Denmark. Their point is that if there were large possibilities for avoidance and evasion, the self-employed would have responded by changing their amount of avoidance and evasion when the tax rates changed.

3.5 Entry and exit

The tax effect on the choice to be self-employed is widely discussed in the literature. Long (1982) analysed the effect of differential tax treatment of wage and self-employment income, and emphasized the welfare costs related to inducing a different labour allocation than the most efficient. His cross section analysis reveals that men who are married, older and live in a rural area are more likely to be self-employed. Furthermore, the main result is that higher tax levels induce more self-employment. The mechanism that is proposed is that the self-employed have larger possibilities for tax evasion, and hence the benefit of being self-employed are larger compared to wage work when the tax level is high.

A quasi-experimental approach to entry and exit has been done by Fossen and Steiner (2009), who use two German tax reforms to identify the effect of income taxes on selection into entrepreneurial activity. In their difference-in-difference-in-differences estimator, they have “tradesmen” with income above a certain threshold as the treated group and assign “liberal professions” and self-employed with incomes below a certain threshold, who did not experience a change in tax rates, as control groups. Their implied elasticity of self-employment probability with respect to the marginal tax rate is -1.36, which is a rather large effect. The results are consistent only if incomes in the treatment and control groups would have followed the same trend in the absence of the tax reform. This counterfactual assumption is by definition impossible to test, but they support the assumption

by showing that the trends were fairly equal before the tax reform took place. Their results imply that lower marginal tax rates for the self-employed will lead to a higher number of self-employed.

Evidence on the relation between taxes and the choice of being self-employed for a Nordic tax system is found in Hansson (2012). She contrasts the Swedish tax treatment of the self-employed, which is fairly similar to the Norwegian, to the American system. It is explained that the American tax system might encourage risk-taking through a favourable tax treatment and ex post choosing of organisational form, while the Swedish system is argued to be more neutral, in the sense that employees and self-employed are treated relatively similarly. These differences can influence the sign of the tax response, where Hansson argues that it is likelier that the effect of taxes on entrepreneurial activity will be negative in Sweden than in US. This is related to the relationship between risk and tax levels, as mentioned in section 2.5. Her findings indicate a small, negative effect of both average and marginal tax levels on the probability of being self-employed, supporting her hypothesis.

3.6 Organisational shifts

Carroll and Joulfaian (1997) explore the relation between taxes and organisational form for corporations in the US around the tax reform of 1986. They find a significant effect of tax changes on organisational form, with an implied tax rate elasticity of 0.20. Furthermore, they discover that those who change organisational form experience higher growth than those who do not.

Organisational shifts in Norway are discussed in Thoresen and Alstadsæter (2010). They find strong evidence of substantial organisational shifting among small businesses over the period 1993 to 2003. The organisational shifting is induced by the dual income tax system, which treats income from self-employment and corporations differently. Incentives to change organisational form were particularly strong for the groups that had a large labour share in their production. The substantial organisational shifting might bias the estimates of the ETI and the working hours elasticity. One way this can work, is that the more successful self-employed change their organisational form, and therefore move out of the definition of the self-employed. How to account for this will depend on the definition of self-employment. As the incentives for organisational shifting were reduced by the 2006 tax reform, it might be an important behavioural response for the self-employed around the reform. Reduced incentives for organisational shifting could result in more individuals staying in the “liable business” category. The effects on the elasticities measured in this thesis will depend on the characteristics of the self-employed that would have changed organisational form under the old tax regime, but did not because of the tax reform.

4. Empirical Strategy

This section will begin by explaining the most important changes in taxation of the self-employed in the period of investigation. Afterwards, the data sources will be introduced and discussed, and the empirical modelling choices and specifications will be explained. Data from the period 2001 to 2010 will be exploited to derive estimates of tax responsiveness. This period includes a major revision of the dual income tax of Norway in 2006.

4.1 The Norwegian Tax System

The Norwegian dual income tax system was introduced in 1992. This meant that capital income was taxed at a low and constant rate, while wage income was taxed at an additional progressive tax rate. It was implemented by a 28 percent rate on corporate income, capital income and labour income, and an additional surtax on labour income. In 2004, the last year before the tax reform (phased in in 2005), the two-tier surtax consisted of rates at 13.5 percent for the first bracket (income exceeding 354,300 NOK) and 19.5 percent for the second bracket (income exceeding 906,900 NOK).

As the dual income tax system gave a more lenient tax treatment of capital income compared to wage income, there were large incentives for the self-employed to characterize their income as capital income. To address this, a split model was introduced to reduce the incentives to re-characterize income. With the split model, part of income was made liable for the surtax, depending on the measure of imputed labour. Imputed labour was calculated as the taxable profits net of imputed return to capital, which was an imputation rate set by the government, multiplied by total assets and human capital contributions. This imputed labour income was then taxed as labour income, while the imputed capital income was taxed at the low constant rate. Income above a certain point (34 G, where G = 58,139 NOK in 2004) was again taxed at the low constant rate, suggesting that high incomes are derived mainly from capital. However, tax rates for the highest incomes changed up to 2004, when a range of very high incomes were taxed according to surtax rates, before returning to the low constant rate for the highest incomes. The split model made it in some sense possible for the tax system to tax income derived from labour and capital at different rates for the self-employed.

However, the liability for imputed labour income to the surtax made the incentives for organisational shifting large. As incorporated businesses were only taxed at a low constant rate, there were large incentives for the self-employed to incorporate, and then avoiding the split model and being paid by dividends. The incentives were particularly prominent for those with large imputed labour income,

who could significantly reduce their tax rates by incorporating. This tension was an important reason for the 2006 tax reform (Finansdepartementet, 2011).

4.2 The 2006 Tax Reform

The Norwegian tax reform of 2006 was essentially a revision of the dual income tax system, and introduced important changes to the tax system. Of the most important changes were reduced surtax rates and the introduction of the enterprise model ("foretaksmodellen"), the shareholder model ("aksjonærmodellen") and the participant model ("deltakermodellen"). Together, they gave a more equal treatment of income earned in different organisational forms and of income derived from capital and labour. In the following the change in the marginal tax rates for the self-employed will be used to identify tax induced behavioural responses.

4.2.1 Changes in income taxation

Changes in the income taxation are central to identification of the elasticities, as they induce exogenous variation in marginal tax rates for the self-employed. Given that data for 2001 to 2010 is used, the baseline tax rate on both wage and business income was 28 percent for all the years considered. The surtax rates consist of two steps, where the first step was an additional tax rate of 13.5 percent in 2001 and the second step 19.5 percent. This had changed to 9 percent and 12 percent respectively in 2010, as seen in Figure 1. In addition, the bracket for which income level the surtax was induced changed over the years. The bracket for the first step stay fairly constant in year 2000 fixed NOK, while the bracket for the second step was reduced significantly from 2004 to 2007, as seen in Figure 2.

When the split model was abolished, some of the really high income earners experienced increased marginal tax rates. However, each year less than one percent of the self-employed individuals earn more than the limit for returning to low constant income tax rates, and the particulars of this feature will therefore not be dealt with.

Figure 1: *Surtax rates*

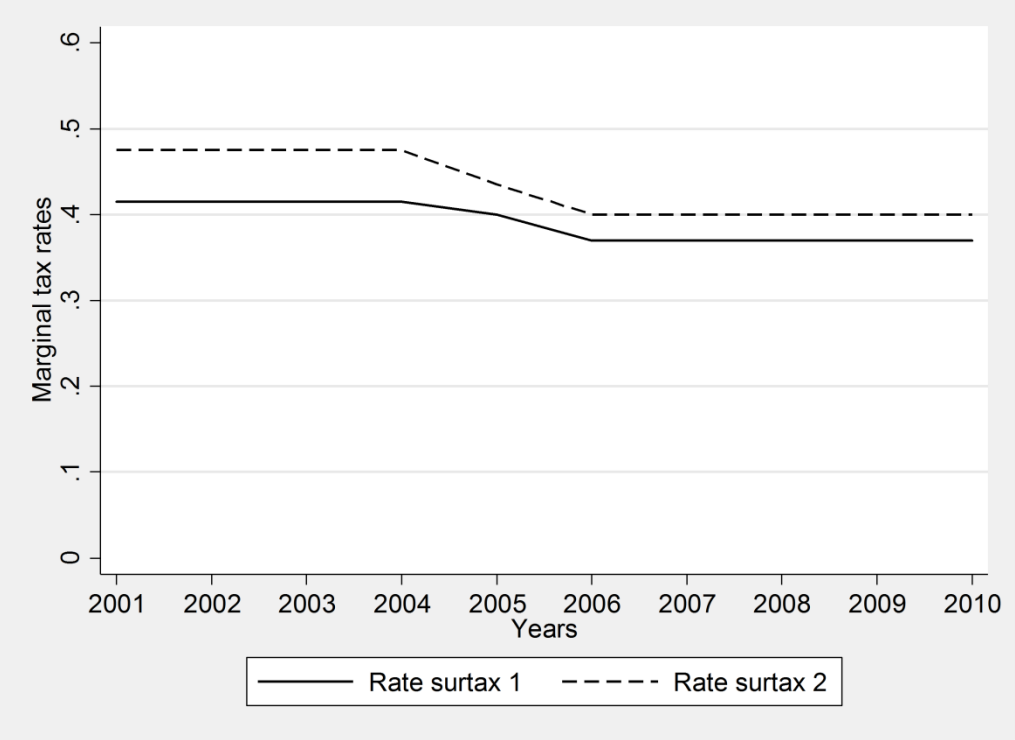
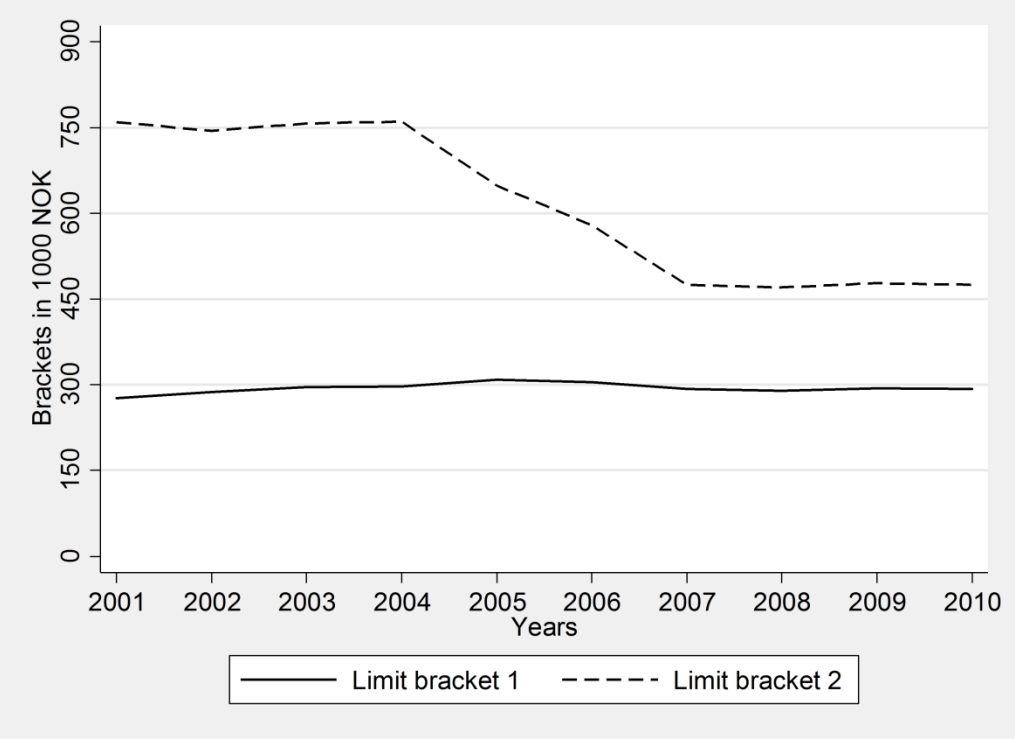


Figure 2: *Wage adjusted surtax brackets*



Year 2000 is the base year.

The changes in both rates and brackets give important variation in the marginal tax rates applied to each self-employed. In addition to these changes, there is a more lenient tax treatment for individuals who live in the most northern part of Norway. Their base level was 24.5 percent, compared to the 28 percent for the rest of the country, for all the years considered. The surtax rate in bracket one was also lower, and the rate there was 9.5 percent until 2005, when it was reduced to 7 percent. For the second step in the surtax, the tax rates were the same independent of where in the country income was earned. The changes in brackets and regional variation are advantageous in the identification of effects.

4.2.2 The enterprise reform

The enterprise reform (”foretaksreformen”) involved changes to the procedure of how the self-employed were taxed. With the reform, the imputed labour system was abolished, and a shielding method (“skjermingsmetoden”) was introduced, where the shielded income is computed by a risk free allowed return to capital investment. The risk free return is calculated by the amount of capital in the firm and the rate-of-return allowance, where the allowance rate is set by the government. Then income above the risk free return is taxed as personal income, subject to surtax rates and social security contributions. This is close to the earlier split model, in that the return to self-employment is still taxed as personal income and made liable for the surtax, which means that for most self-employed marginal tax rates were probably not affected much by this change.

For shareholders (“foretaksmodellen”) and partners in partnerships (“deltakermodellen”) taxation on the personal level begins when returns and capital gains are realised and are above the normal rate of return set by the government. The exemption method included in the shareholder model means that dividends are now taxed both at the corporate and the individual level, with the risk-free allowance taxed only at the corporate level. These changes made the tax treatment of shareholders and partners in partnerships more equal to that of the self-employed, which then most likely reduced the incentives for organisational shifting among the self-employed. The impact of these changes will not be directly investigated, but will affect the measurement of tax responses as the composition of tax-payers among the self-employed is influenced by this.

4.3 Data

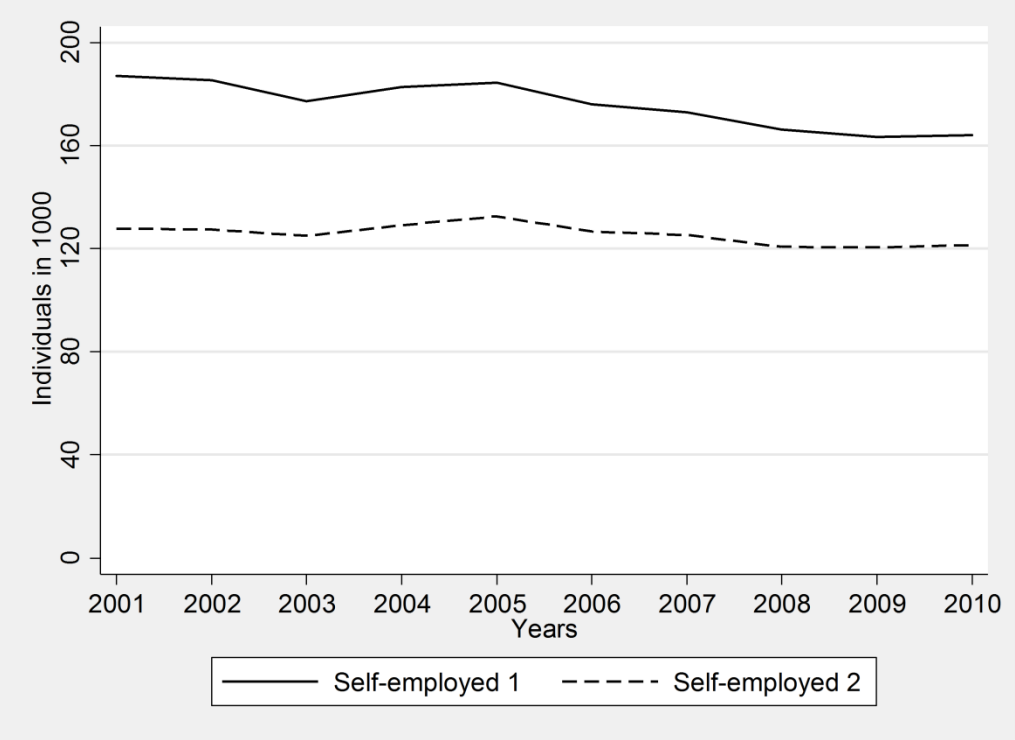
As discussed in the Introduction, two data sets are used in the empirical analysis. The first is Income Statistics for Families and Persons (Statistics Norway, 2005) and the second is the Labour Force Survey (Statistics Norway, 2003). Because both data sets include personal ID numbers, the same characteristics and marginal tax levels can be computed for both empirical analyses by utilizing the information provided in the income data set.

There are multiple definitions of the self-employed used in the literature, from self-reported self-employed, owners of businesses that are not incorporated, to how much of their income is related to self-employment activity. I follow the last route for my definitions. The first definition of self-employment used here is obtained from a restriction of business earnings higher than wage earnings. This means that the self-employed I consider may have wage income, but that their main income is derived from self-employment.

A second categorization used is based on excluding self-employed in the primary industries. The main reason for excluding the primary sector is that they are subsidised, which can influence their responses to taxation, especially if the subsidies change at the same as the taxes. A limitation with both definitions is that they only include the self-employed that do not run losses. Hence, the definitions give the individuals that have self-employment as their main source of income.

As mentioned, the analysis is restricted to 2001 to 2010, because these are the years around the reform, the number of self-employed is fairly stable over these years and all the important variables I need are available in the data sets for these years. As Figure 3 shows, the number of self-employed according to both definitions has been fairly stable in Norway around the tax reform of 2006. However, this does not mean that it has not been a large amount of entry and exit into self-employment in this period.

Figure 3: *Number of self-employed individuals each year*



4.3.1 Income register data: panel

In the estimation of the ETI, register panel data of all incomes for persons in Norway is exploited. Some characteristics and other information about the individuals are also available in the dataset. In addition to addressing information for the time period 2001 to 2010, I restrict to individuals with non-missing and non-zero self-employment income from 2004 to 2007, to those with higher self-employment income than wage earnings from over the same period, and to self-employed who are between 20 and 65 years old in 2005. This leaves me with almost 100,000 individuals over 10 years. These are the individuals who have self-employment income as their primary income source in the years around the reform. Descriptive statistics for this group of self-employed are given in Table 1, Table 2 and Table 3.

Table 1: *Income and net-of-tax rates*

	Reported income	Net-of-tax rates
	Mean	Mean
2001	293381	0.656
	(298203)	
2002	308696	0.662
	(281917)	
2003	309521	0.668
	(285493)	
2004	337262	0.665
	(304787)	
2005	357667	0.673
	(369662)	
2006	389359	0.681
	(399292)	
2007	424129	0.676
	(419028)	
2008	432964	0.677
	(380179)	
2009	433379	0.681
	(392211)	
2010	450710	0.681
	(411787)	

mean coefficients; sd in parentheses

Table 2: *Observable characteristics*

	Mean
Sex	0.74
Age	47.9
Children	0.54
Married	0.58
Birth country	0.92

Table 3: *Education*

Educational level	Percentage
No education	0.1
Primary school	0.2
Secondary school	17.5
High school, started	19.6
High school, completed	29.4
High school, supplement	2.5
University, undergrad	16.1
University, postgrad	12.6
Research degree	0.4
Unknown	1.6
Educational field	**Percentage**
General	27.4
Humanities and arts	5.9
Teaching	2.3
Social science and law	4.6
Business and administration	10.3
Science, crafts and technology	24.9
Health, social and sports	14.3
Agriculture and fishery	2.0
Transport, security and services	5.9
Unknown	2.3

I use the tax base for the surtax as my dependent variable. Marginal tax rates are computed given income in the surtax base and using information about the tax system from Skatteetaten (2015). As seen in Table 1, net-of-tax rates increased in 2005 and 2006, supporting the presumption that the 2006 tax reform lowered marginal tax rates on average. However, they did not go down by much. This is likely because although surtax rates were reduced, so were also the limit for paying surtax bracket two, which meant that more people were paying the surtax after 2006. In addition the marginal tax rates for some high income earners increased; see the description of the tax schedule for the self-employed in Section 4.1.

In Table 2 it is seen that 74 percent of the self-employed considered are male, the average age is 47.9 years, 54 percent have children, 58 percent are married and 92 percent are born in Norway. Dummies for level and field of education are created by information provided in the income data set. The description of the Norwegian Standard Education Classification is provided in Statistics Norway (2000). As seen in Table 3, most of the self-employed have high school completion as their highest

level of education and a general field of education. Dummies for each county in Norway are created by information about to which municipality income is reported.

4.3.2 Labour force survey: repeated cross-section

To obtain separate response estimates based on working hours information from the Labour Force Survey ("Arbeidskraftundersøkelsen") for the time period 2001 to 2010 is used. The Labour Force Survey is a sample survey and respondents report their hours of work in the main occupation and in total. About 24,000 people are asked each quarter, and some are asked two or three quarters, but not all. These data will be exploited as repeated cross section in the following. There are both advantages and disadvantages to this. An important disadvantage is that panel data methods are not available. An advantage is that the problem of mean reversion will not be present, as there are mostly different people observed each year; see Giertz (2008) for a discussion. The number of observed individuals is smaller in this dataset than for the income data.

As mentioned, the data consists both of hours of work in main occupation and in total. I use hours of work in the main occupation as the main variable. The data restrictions will imply that working hours in self-employment is derived.

Survey data can be less reliable than register data because of potential misreporting. The problem can be especially large for working hours of the self-employed, as their working hours are not necessarily well-defined. What is important in my case is that the misreporting is the same for those who experienced changes in their marginal tax level and those who did not. This does not seem entirely implausible. Some of the measurement problems will then be differenced out by the identification method.

The treated group is the self-employed who have lower marginal tax rates after the reform than they would have had absent the reform. The first control group (Control group 1) consists of those who are self-employed and have the same marginal tax levels as they would have had absent the reform. The second control group (Control group 2) consists both of self-employed and wage earners that have the same marginal tax levels as they would have had absent the reform. To obtain good control groups, I restrict to those that earned more than 200,000 NOK, and who were more than 20 and less than 60 years old in 2005. Some descriptive statistics about the groups are given in Table 5, Table 6 and Table 7.

Table 4: *Hours of work*

	Treated		Control 1		Control 2	
	Hours of work	Net-of-tax rate	Hours of work	Net-of-tax rate	Hours of work	Net-of-tax rate
Before reform	41.1	0.616	41.5	0.720	34.8	0.720
	(9.0)		(9.4)		(6.1)	
After reform	40.8	0.652	40.1	0.710	34.2	0.714
	(9.1)		(9.9)		(6.8)	

mean coefficients; sd in parentheses

Table 5: *Observable characteristics*

	Treated Mean	Control 1 Mean	Control 2 Mean
Sex	0.79	0.71	0.32
Age	47.8	48.9	44.7
Child	0.58	0.58	0.54
Married	0.61	0.64	0.52
Birth country	0.93	0.96	0.94

Table 6: *Education*

Educational level	Treated Percentage	Control 1 Percentage	Control 2 Percentage
No education	0.0	0.0	0.1
Primary school	0.1	0.0	0.1
Secondary school	15.3	20.1	16.5
High school, started	16.2	26.6	23.0
High school, completed	28.0	35.5	33.3
High school, supplement	2.4	2.2	2.9
University, undergrad	16.6	11.3	21.6
University, postgrad	19.2	3.35	1.6
Research degree	0.8	0.0	0.1
Unknown	1.3	0.9	0.7
Educational field	**Treated Percentage**	**Control 1 Percentage**	**Control 2 Percentage**
General	24.0	27.1	28.1
Humanities and arts	4.0	5.1	4.7
Teaching	2.4	2.3	7.5
Social science and law	5.8	0.0	1.4
Business and administration	10.0	10.6	14.8
Science, crafts and technology	25.8	27.4	18.6
Health, social and sports	20.6	9.2	19.2
Agriculture and fishery	2.0	2.9	1.5
Transport, security and services	3.7	14.5	2.9
Unknown	1.8	0.9	1.3

Table 4 shows the average hours worked in main occupation for the three groups and their marginal tax rates, before and after the tax reform. There has been a reduction in working hours in all groups, but the reduction is largest among the self-employed used as controls. The treated have experienced increased net-of-tax rates, while the two control groups experienced slightly lower net-of-tax rates.

In Table 5 and Table 6 it is seen that the treated and the first control group, the self-employed, have largely the same characteristics as in the income data. This is reassuring for the use of the Labour Force Survey data. The second control group have different characteristics, as wage earners differ from the self-employed in some aspects.

4.4 Specifications

Here I present the strategies for identification of the ETI and the working hours elasticity for the self-employed. The two strategies share important features, in that they are both quasi-experimental and rely on some individuals being more treated and some less treated, and then comparing across treatment statuses. In addition, both approaches rely on a common trend assumption, which is explained and addressed separately for the two strategies.

The methodology presented here identifies effects on the self-employed that are treated, which means the effects will only be measured for those who are affected by the tax reform. For the income estimation, the effect measured will be the change in income caused by changes in marginal tax rates for those who experienced changes in marginal tax rates as a result of the tax reform. For the hours of work estimation, the effect measured will be the change in working hours caused by changes in marginal tax rates for those who experienced lower marginal tax rates as a result of the tax reform. As these are estimates only for the groups affected by the reform, they are not general averages for the whole population. This means that the estimates can only have external validity for tax changes affecting the same groups as the 2006 tax reform. As the tax changes mainly affected middle and high income earners, the behavioural responses obtained here may be different compared to corresponding estimates for low income earners. However, because the groups the effects are measured on are fairly broad, the estimates are not without some generality.

4.4.1 Panel data analysis

To estimate the ETI for the self-employed, I use the panel dataset for incomes described in the preceding section. My specification follows closely techniques described in Gruber and Saez (2002), Kopczuk (2005) and Heim (2010). Given the large sample size, the focus will be on consistency of the estimates, and not on finite sample properties or the standard errors.

I follow the literature by using three-year differences, which is a first differences approach where the variable three time periods before is subtracted instead of the period before. Three-year differences are used to estimate a medium term response and to avoid picking up the potentially large short term income shifting responses.

To see the properties of this, let the underlying relationship be

$$\ln(I_{i,t}) = \nu_t + \beta \ln(1 - \tau_{i,t}) + c_i + \psi_t B_i + \omega_t M_{i,t} + u_{i,t} \,, \tag{4.1}$$

where $I_{i,t}$ is taxable income for individual i in period t and $(1 - \tau_{i,t})$ is the net of marginal tax rate for the same individual in the same time period. A log-log specification is used to estimate the elasticity directly, in addition to the fact that it is often a better way to estimate effects on incomes, as the log will reduce the importance of very large incomes. c_i is an unobserved time non-varying effect, or in other words, an unobserved characteristic that has a constant relationship with income. If c_i is correlated with $\ln(1 - \tau_{i,t})$, not using a difference method can lead to a large omitted variable bias. ν_t is a time specific effect. B_i contains individual characteristics that are time-invariant, but that can change relationship with income over time, see Auten and Carroll (1999), and $M_{i,t}$ contains characteristics that may change over time and which relation to the dependent variable may change over time. The error term is assumed to be independently and identically distributed.

In three year differences we have

$$\ln(I_{i,t}) - \ln(I_{i,t-3}) \,. \tag{4.2}$$

Hence,

$$\ln\left(\frac{I_{i,t}}{I_{i,t-3}}\right) = \alpha_t + \beta \ln\left(\frac{1 - \tau_{i,t}}{1 - \tau_{i,t-3}}\right) + \theta B_i + \eta M_{i,t} + \varepsilon_{i,t} \,, \tag{4.3}$$

where $I_{i,t}$ is taxable income in year t, $I_{i,t-3}$ is taxable income in the base year, $\tau_{i,t}$ is the marginal tax rate in year t, and $\tau_{i,t-3}$ is the marginal tax rate at the base year, and α_t is the differenced time-specific constant. The same goes for the time varying effect of observable characteristics, which

difference now can be written as θ and η, assuming that the characteristics have a time constant effect on the difference in income. By differencing, the unobserved time non-varying effect is removed.

The first-differences estimator is just the OLS estimator on differenced variables. However, the marginal tax rates are clearly endogenous, as they are decided by the income level. This means that naïvely estimating income as the regressand and the marginal tax rate as the regressor will lead to a bias. Therefore, it is necessary to use an instrumental variable approach.

I follow the literature, and use as instrument the tax rate in year t applied to income in year $t-3$, inflated by income growth. This means that $\ln\left(\frac{1-\tau_{i,t}}{1-\tau_{i,t-3}}\right)$ is instrumented by $\ln\left(\frac{1-\tau^{I}_{i,t}}{1-\tau_{i,t-3}}\right)$, where $\tau^{I}_{i,t}$ is the marginal tax rate in year t applied to income in year $t-3$, inflated by income growth for all three years. The instrument is in a sense the marginal tax rate that would have been faced if there were no behavioural responses. This is the change in the tax rate that is only due to the tax reform.

To estimate first-differences with IV, standard 2SLS is used, which gives the estimator

$$\hat{\beta}_{FD\,IV} = \left((Z_t - Z_{t-3})'(X_t - X_{t-3})\right)^{-1}(Z_t - Z_{t-3})'(\mathrm{y_t} - y_{t-1})\,, \tag{4.4}$$

where $(Z_t - Z_{t-3})$ is the instrument for $(X_t - X_{t-3})$.

To be a good instrument, in the sense that it will give consistent estimates, it needs to be valid and relevant. Relevance is easily checked by the first stage, and it is clear that the tax rates that would have been faced had income not changed, will be strongly correlated with the actual tax rates. The instrument is valid if it is uncorrelated with the error term in Equation 4.4 and it is rightly excluded from Equation 4.4. These are the independence assumption and the exclusion restriction. The latter will hold if the change in the marginal tax rates that is only due to the reform only affects the changes in income through the changes in the marginal tax levels.

The crucial identifying assumption is instrument validity, which in this case can be written as

$$E\left(\ln\left(\frac{1-\tau^{I}_{i,t}}{1-\tau_{i,t-3}}\right)(u_{i,t} - u_{i,t-3})\right) = 0\,. \tag{4.5}$$

It is a fairly strong assumption, and the main problem is mean reversion. It follows from exceptionally high income one year being more likely to be followed by less income the next year. The same holds in the opposite direction for particularly low incomes one year. This can seriously bias the estimates, likely downwards for a tax decrease, as high earners are more likely to be lower earners next period,

while it is the opposite for low earners. Another problem of the same character is exogenous trends in income. If, simultaneously as the tax reform there is a trend towards greater inequality, meaning that the high income earners increase their income more than the low income earners, that is not related to the tax levels, this will result in biased estimates. Of course, there can be a trend towards greater equality as well, leading to the same problem in the opposite direction. If there is a trend towards greater inequality that is not caused by the tax levels, then this will bias the estimates upwards for a tax decrease. The two issues probably work in opposite directions, but there is nothing indicating that the effect of trends in income and of mean reversion should cancel out.

To address these issues, I follow Auten and Caroll (1999) and Gruber and Saez (2002), and include the log of base year income on the right hand side. This changes the interpretation of the instrument, so the instrument is valid if it is uncorrelated with the error term given the log of base year income.

In addition, I add some observable characteristics and time dummies. If the change in income is affected by some unobservable characteristics that are correlated with the changes in the marginal tax rates, this can be a problem. The problem is addressed by including dummies for the characteristics sex, age, having children, marriage, being born in Norway, educational level, educational field and county. The specification is then

$$\ln\left(\frac{I_{i,t}}{I_{i,t-3}}\right) = \alpha_t + \beta \ln\left(\frac{1-\tau_{i,t}}{1-\tau_{i,t-3}}\right) + \theta B_i + \eta M_{i,t} + \rho \ln\left(I_{i,t-3}\right) + \varepsilon_{i,t}\,, \qquad (4.6)$$

where $\ln\left(\frac{1-\tau_{i,t}}{1-\tau_{i,t-3}}\right)$ is instrumented by $\ln\left(\frac{1-\tau^{I}_{i,t}}{1-\tau_{i,t-3}}\right)$, $\ln\left(I_{i,t-3}\right)$ is log of income in the base year and α_t are the time dummies. B_i contains the non-time varying covariates and $M_{i,t}$ contains the potentially time-varying covariates.

To better control for mean reversion and trends in income, the literature has turned to adding splines in the log of base year income. These splines are nonlinear functions at some specified points of the income distribution. Gruber and Saez (2002) propose adding ten piece splines in the log of base year income, at each decile of the income distribution. Kopczuk (2005) argues that splines in the lagged of base year income and in the deviation of lagged of base year income from base year income, will be a better approach. These approaches can be seen as

$$\ln\left(\frac{I_{i,t}}{I_{i,t-3}}\right) = \alpha_t + \beta \ln\left(\frac{1-\tau_{i,t}}{1-\tau_{i,t-3}}\right) + \theta B_i + \eta M_{i,t} + \mu Splines \ln\left(I_{i,t-3}\right) + \varepsilon_{i,t}\,, \qquad (4.7)$$

in the Gruber and Saez speciation, and

$$\ln\left(\frac{I_{i,t}}{I_{i,t-3}}\right) = \alpha_t + \beta \ln\left(\frac{1-\tau_{i,t}}{1-\tau_{i,t-3}}\right) + \theta B_i + \eta M_{i,t} + \phi Splines \ln\left(I_{i,t-4}\right) + \pi Splines \ln\left(\frac{I_{i,t-4}}{I_{i,t-3}}\right) + \varepsilon_{i,t}\,, \tag{4.8}$$

in the Kopczuk spefication.

These equations are estimated by 2SLS where the instrument is as specified above.

The error terms may exhibit both serial correlation and heteroskedasticity. To account for this, standard errors are clustered at the individual level, which then is robust to both serial correlation and heteroskedasticity.

In Appendix A.2, the system is modelled to provide a presentationally different, though essentially equivalent, explanation of the role of the instruments and the controls for trends and mean reversion.

4.4.2 Repeated cross-section analysis

As already noted, in the estimation of effects on working hours a standard difference-in-differences methodology is followed, as repeated observations of individuals' working hours are not available; see for example Angrist and Pischke (2009) on the method. The main idea is to assign some individuals to a treatment group and some to a control group, and then compare the two groups before and after an exogenous change in policy. Hence, the difference from the panel data analysis is that the unobserved effect is differenced out on the group level instead of at the individual level. The central part of the difference-in-differences approach is therefore to construct a comparable treatment and control group. Then the difference-in-differences estimator is the difference between the difference in means before and after the policy change. It can be employed in a regression framework by using a dummy for being treated, a dummy for post reform or for each year, and an interaction dummy between treated and post reform. With the regression framework, controls can also be added, in this way

$$h_{i,t} = \xi + \gamma D_i + \lambda Q_t + \delta D_i Q_t + \theta B_i + \eta M_{i,t} + \epsilon_{i,t}\,, \tag{4.9}$$

where $h_{i,t}$ is working hours, ξ is a constant, D_i is a dummy for being treated or not, $Q_t$is a dummy for post reform, $D_s Q_t$ is the interaction between the two preceding dummies, B_i contains characteristics which do not change over time, $M_{i,t}$ contains characteristics that may change over time. The post

reform dummy can be changed to time dummies for each period, α_t, where the identification will be exactly the same, but more time varying effects will be controlled for.

The crucial identifying assumption is the common trend assumption, which means that if the reform did not take place, the trends in the parameter of interest would have been the same for the treatment and the control group. This can be written by considering the counterfactual assumption that

$$E\left[h_{i,t}^{o} \mid s, t, B_i, M_{i,t}\right] = \gamma_s + \alpha_t + \theta B_i + \eta M_{i,t} \,, \tag{4.10}$$

where $h_{i,t}^{o}$ is the potential outcome of individual i at time t, absent the reform, s is which group the individual belongs to, t is the time period, γ_s is the group-specific effect, α_t is the time trend, while θ and η are the effects of other individual characteristics. This means that the potential outcome in the absence of the reform should be additive in structure, which is necessary because what the difference-in-differences does, is to account for differences on the group level and time trends that are equal for both groups. Hence, given the characteristics of the individuals, there should be a separate additive effect of belonging to the treated or the control group, γ_s, and a separate additive effect of the time trend, α_t, which must be equal for the treatment and control groups. Then the treatment effect can be identified.

In the same way as with panel data, exogenous trends in the parameter of interest would cause trouble. The problem is that exogenous trends would mean that the time trend absent the reform would not be equal for each of the groups, in other words a violation of the common trend assumption. However, to control for a base year variable is not as important in this application as with the income analysis because mostly different people are observed each year and then there is no mean reversion.

The treated are defined as those that had higher instrumented marginal tax rates in the three years following the reform, compared to the three years preceding the reform. The control group is defined as those that had the same instrumented marginal tax rates in the three years following the reform as the three years preceding the reform. Hence, the Q-variable takes the value one if the individual is assigned to the treatment group, zero if the individual is assigned to the control group and is missing otherwise. The “instrument” used to define the treatment groups is the same as in the ETI-estimation, namely the marginal tax rates that would have been faced, had income stayed the same as three years ago, corrected for inflation, which is

$$\ln\left(\frac{1-\tau_{i,t}^{I}}{1-\tau_{i,t-3}}\right). \tag{4.11}$$

Post reform is defined as after 2005, while pre reform is defined as before 2005. Two main specifications are used. One where the dependent variable is reported hours worked each week in levels form and the other in log-form. Furthermore, as there are data limitations in this application, I will first use self-employed as both treatment and control, and then add wage earners to the control group to improve the precision of the estimates. Dummies for the characteristics sex, age, having children, marriage, born in Norway, educational level, educational field and county are added. The specifications are then

$$h_{i,t} = \alpha_t + \gamma D_i + \delta D_i Q_t + \theta B_i + \eta M_{i,t} + \varepsilon_{i,t} \tag{4.12}$$

$$\log(h_{i,t}) = \alpha_t + \gamma D_i + \delta D_i Q_t + \theta B_i + \eta M_{i,t} + \epsilon_{i,t}\,, \tag{4.13}$$

where $h_{i,t}$ is reported hours worked per week, α_t are time dummies, D_i is a dummy for being treated or not, $D_i Q_t$ is an interaction dummy between treated and post reform. B_i contains the non-time varying covariates and $M_{i,t}$ contains the potentially time-varying covariates.

The elasticity of hours must be multiplied by $\frac{wh}{z}$ to obtain an indication of what proportion the hours of work response is of the ETI, as showed in Equation 2.25 and Equation 2.26.

5. Results

This section presents the main empirical findings in the thesis.

5.1 Elasticity of Taxable Income

Table 7: *ETI*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
Net-of-tax rate	-3.037***	-1.067***	0.131***	0.201***	0.215***
	(0.008)	(0.013)	(0.017)	(0.019)	(0.018)
Age	-0.004***	-0.009***	0.002***	0.002***	-0.002***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	0.000***	0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.007***	-0.002	0.043***	0.047***	0.038***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Birth country	-0.003	0.001	-0.013***	-0.010***	-0.004
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Children	0.014***	0.018***	0.027***	0.024***	0.025***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Married	0.006***	0.007***	0.019***	0.019***	0.018***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
N	577683	577649	577649	577649	495363

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Coefficients on year dummies, lagged dependent variables and splines are not shown

Table 7 reports the results of five different specifications to obtain estimates of the ETI for the self-employed. The first column in the table present ordinary least squares estimates on the differenced equation, resulting in a clearly negative parameter estimate for the net-of-tax-rate. With IV and not controlling for base year income, corresponding to the specification in Equation 4.6, the estimated elasticity is still negative. Controlling for base year income gives positive estimates. First, a simple control results in an elasticity of 0.13 (column 3). Introducing splines in base year income further increases the estimated elasticity, to 0.20 (column 4), with the Gruber and Saez specification, corresponding to the specification in Equation 4.8, and 0.22 (column 5), with the Kopczuk specification, corresponding to the specification in Equation 4.9. The interpretation of the last estimate is that if the net-of-tax rate increases by one percent, income increases by 0.22 percent. Because the estimates should be comparable to the corresponding estimates for the effect on working hours, not all control variables are included in the estimation leading to Table 7.

Table 8: *ETI with additional control variables*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
Net-of-tax rate	-3.040***	-1.060***	0.159***	0.135***	0.188***
	(0.009)	(0.014)	(0.018)	(0.019)	(0.019)
Age	-0.002***	-0.007***	0.004***	0.004***	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	0.000	0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.009***	-0.005***	0.091***	0.086***	0.067***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Birth country	0.001	-0.003	0.019***	0.017***	0.013***
	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)
Children	0.008***	0.011***	0.017***	0.016***	0.016***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Married	0.006***	0.007***	0.017***	0.016***	0.016***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
N	493441	493414	493414	493414	423229

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Coefficients on year dummies, lagged dependent variables, splines, county, education level and educational field are not shown

In Table 8, results when adding additional control variables are presented (leading up to a similar distinction for working hours). The parameter estimates are not influenced much by this, but the result in the Gruber-Saez specification is to some extent different.

Results of further sensitivity analyses are presented in Appendix A.3.1. I find the results to be fairly stable across specifications, and the Kopczuk specification to be the most stable. The estimates of the ETI for the Kopczuk specification are 0.153 when only those that earn higher business income than wage income for all the ten years are included and 0.147 when those that earn more income from business in the primary sector than other sectors are excluded. It is 0.189 when income less than 100,000 is excluded, 0.164 with business income as the dependent variable, and 0.173 when the sample is restricted to individuals with nonzero and non-missing business income for all years in addition to the restriction used in the baseline estimation. It is 0.225 when the estimation is done on self-employed that are also in the working hours data set; in other words those that have been part of the Labour Force Survey. The estimated elasticity is 0.077 when addressing tax-payers with nonzero and non-missing business income for all years are considered. That this elasticity is considerably lower is not surprising, as this is a very wide definition of self-employment, meaning that many of these individuals will have wage earning as their main activity.

Compared to Thoresen and Vattø's (2013) estimate of an ETI of about 0.05 for wage earners for the same tax reform, the self-employed seem to respond more. This is expected, as the self-employed have larger possibilities for choosing their own working hours and shelter taxes. Kleven and Schultz (2014) obtain an ETI of 0.10 for the self-employed in Denmark, and they find it to be about twice as large as the ETI for wage earners. According to the results presented here, the Norwegian self-

employed seem to respond more in the years around the 2006 tax reform than the Danish self-employed around the reforms considered by Kleven and Schultz. Their definition of self-employed is however less restrictive than mine, which may account for some of the difference in elasticity measured. My ETI results are very close to the elasticities obtained on Danish data by Le Maire and Scherning (2013) using the bunching method and controlling for income shifting. Heim's (2010) estimate of an ETI of 0.9 for the self-employed is much larger than the present estimates. However, when Heim deduct the response due to tax evasion, an ETI of 0.4 is found, and this is closer to the estimates presented here.

5.2 Elasticity of Working Hours

5.2.1 Graphical evidence

Next, estimates for the hours of work specifications (see Equation 4.12 and Equation 4.13) are presented. First, Figure 4 and Figure 5 give a picture of the development of working hours for the tax-payers experiencing an increase in the net-of-tax-rate induced by the reform and the control group including wage earners.

Figure 4: *Hours of work for the treatment and control group (wage earners included)*

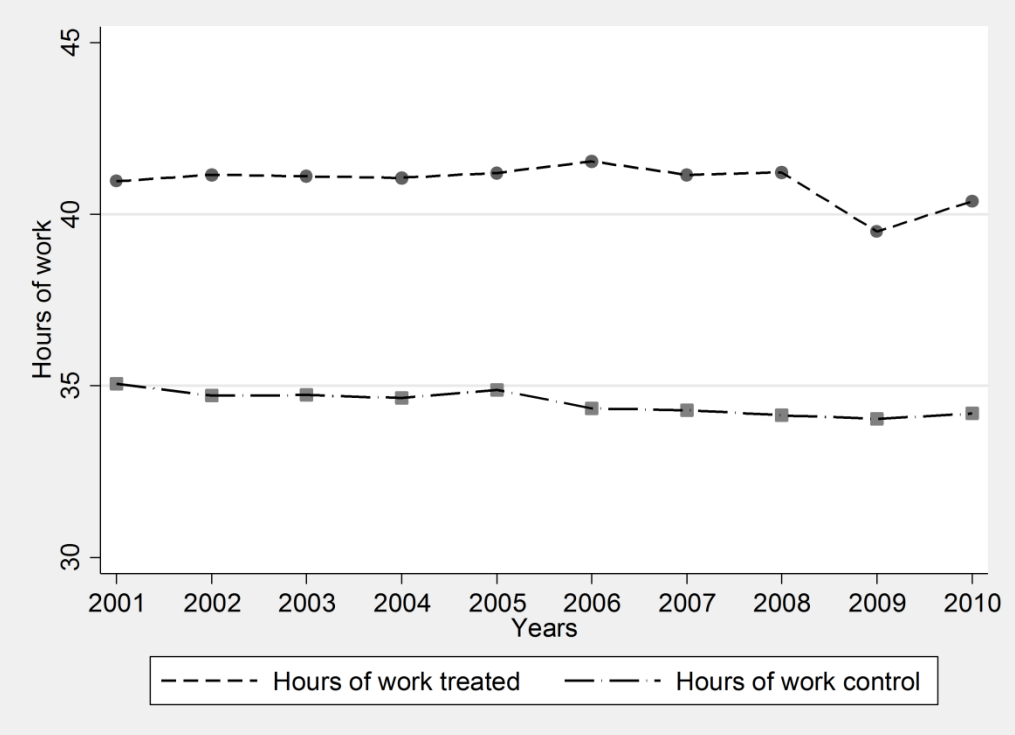
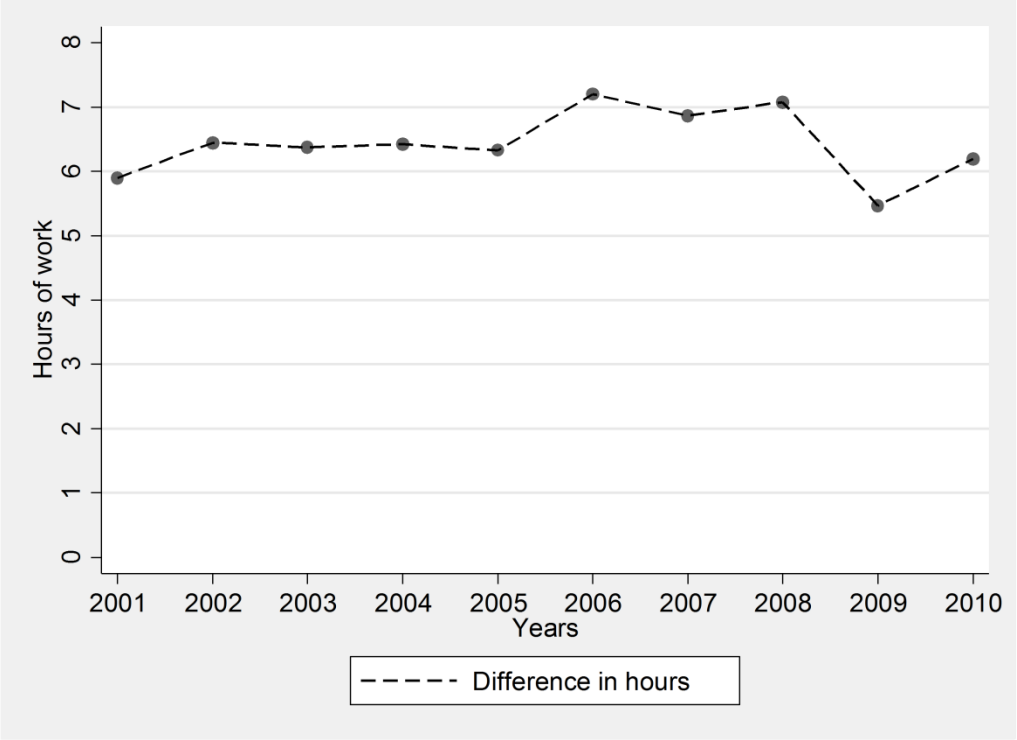


Figure 5: *Difference in hours worked between treatment and control group (wage earners included)*



As seen in Figure 4, for all the years considered, average weekly work hours are higher for the treated than for the control group. This is because the self-employed on average work more hours than wage earners. Figure 5 shows that the difference in hours between the treated and the control group increases right after the tax reform, which may indicate that the treated self-employed have responded to the fall in marginal tax rates. However, the difference falls steeply in 2009. If the financial crisis had a larger negative impact on high self-employed income than low self-employed and wage earned income, this may explain the fall in that year. For the difference-in-differences to give meaningful estimates, the common trend assumption is crucial. Figure 4 shows trends in working hours being fairly similar for the treatment and control group before the 2006 tax reform, supporting the validity of the common trend assumption.

Figure 6 and Figure 7 give a picture of the development of working hours for the treated and the control group containing only self-employed.

Figure 6: *Hours worked for the treatment and control group (self-employed only)*

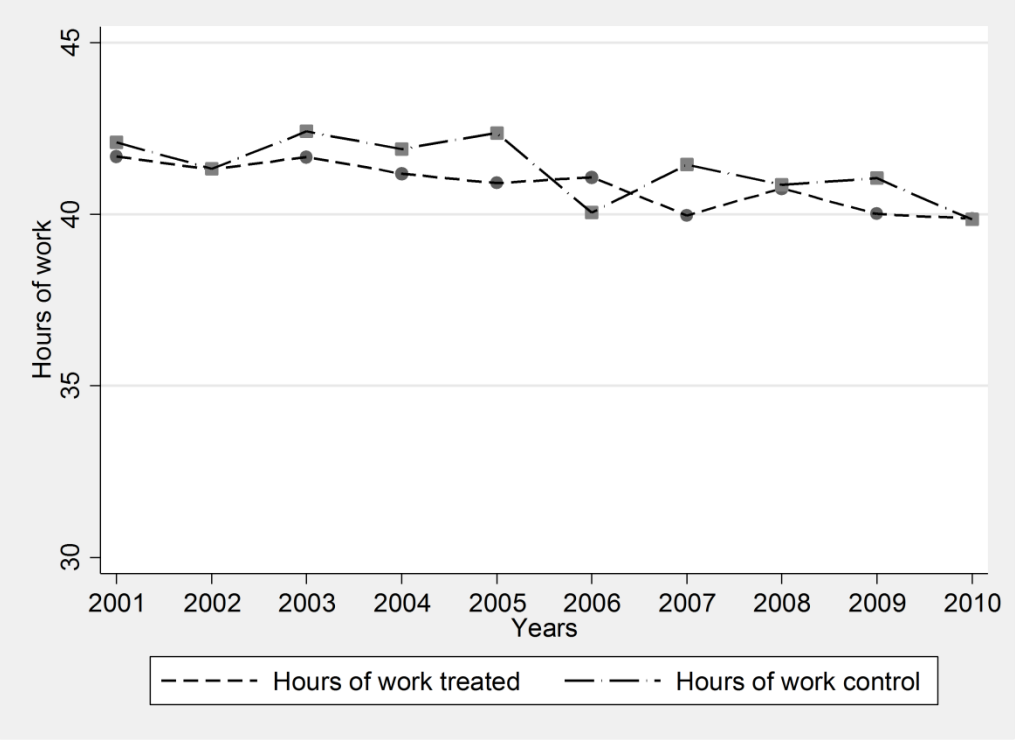
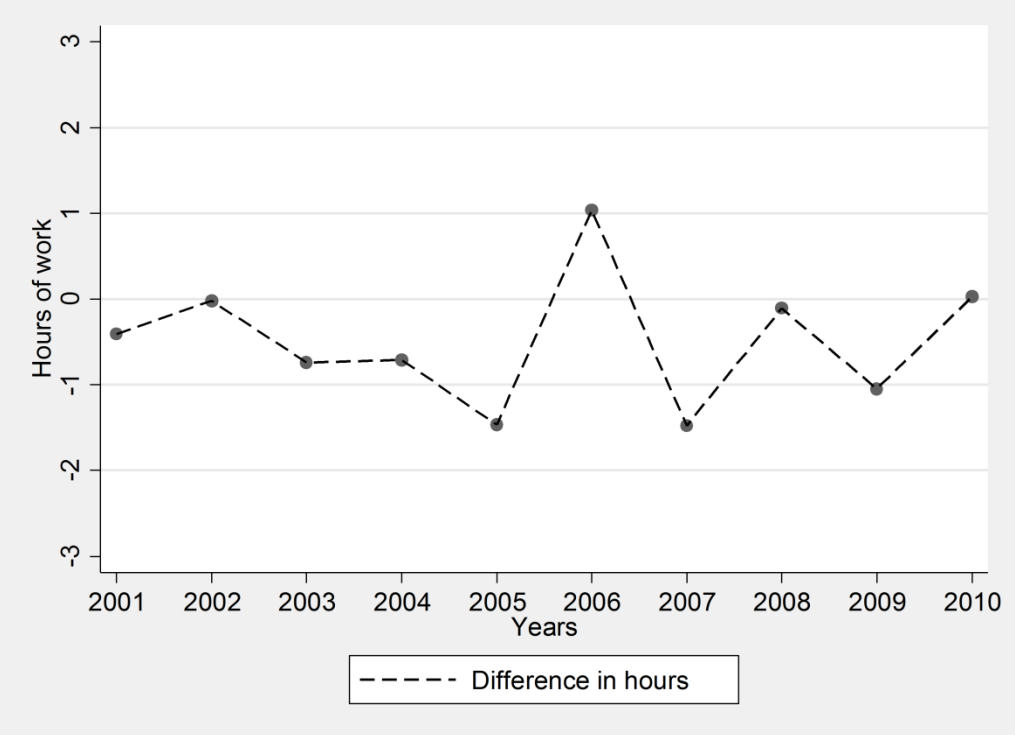


Figure 7: *Difference in hours worked between treatment and control group (self-employed only)*



As seen in Figure 7, when only using data on the self-employed (excluding wage earners from the control group), the picture is less clear. There is a steep increase in the difference in hours just after the tax reform, but already the year after (2007) working hours return back. On average, hours worked seem to be fairly equal for the high and low earning self-employed.

Further graphical analyses are provided in the Appendix A.3.2, where the difference in average hours worked is looked at by its change from the year before. Descriptions are basically the same as here.

5.2.1 Estimated elasticity

Table 9: *Elasticity of working hours*

	(1) Level	(2) Log	(3) Level – large control	(4) Log – large control
Tax treatment	0.016	0.005	0.236	0.012*
	(0.613)	(0.016)	(0.225)	(0.007)
Treated	-0.640	-0.014	4.801***	0.112***
	(0.445)	(0.012)	(0.161)	(0.005)
Children	-0.778**	-0.021**	-0.518***	-0.016***
	(0.372)	(0.010)	(0.070)	(0.002)
Married	0.071	0.002	-0.535***	-0.016***
	(0.359)	(0.009)	(0.065)	(0.002)
Birth country	3.304***	0.089***	0.155	0.003
	(0.618)	(0.016)	(0.126)	(0.004)
Sex	6.479***	0.171***	3.848***	0.113***
	(0.364)	(0.009)	(0.060)	(0.002)
Age	0.592***	0.016***	0.129***	0.004***
	(0.143)	(0.004)	(0.023)	(0.001)
Age squared	-0.007***	-0.000***	-0.002***	-0.000***
	(0.001)	(0.000)	(0.000)	(0.000)
Constant	22.238***	3.180***	32.067***	3.452***
	(3.435)	(0.089)	(0.500)	(0.015)
N	3822	3822	48779	48779

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies are not shown

Table 9 reports the estimation results when applying four different specifications. The first column is hours in level form as the dependent variable and using data on the self-employed, the second column is with hours in log form and exploiting data on the self-employed, the third column is with hours in level form and including wage earners in the control group, the fourth column is with hours in log form and wage earners included. Estimates of the tax effect are reported in the first row, and differ according to specification. The coefficient found in the first column translates to an elasticity of working hours of 0.008 and the second column translates to an elasticity of 0.095. With the wage earners included in the control group (column 3 and 4), the estimates translate to elasticities of working hours of 0.114 and 0.191 for the level and log specification, respectively.

Only for the log specification and including wage earners is a significant effect found. This approach is found more stable across other changes to specifications, and can be seen as the baseline estimate. The interpretation is that if the net-of-tax rate increases by one percent, hours of work increases by 0.19 percent.

Considering the preceding graphs, the results are not surprising. The effect is larger when wage earners are also used as controls, in addition to the increased power by having more observations in the control group. Both indicate a larger and more significant treatment effect for column 3 and 4 in Table 9.

Table 10: *Elasticity of working hours with additional control variables*

	(1) Level	(2) Log	(3) Level – large control	(4) Log – large control
Tax treatment	0.172	0.008	0.099	0.007
	(0.903)	(0.023)	(0.396)	(0.010)
Treated	0.357	0.010	4.676***	0.107***
	(0.696)	(0.018)	(0.307)	(0.008)
Children	-0.920*	-0.027**	-0.551***	-0.017***
	(0.479)	(0.012)	(0.092)	(0.003)
Married	-0.042	-0.000	-0.660***	-0.020***
	(0.475)	(0.012)	(0.087)	(0.003)
Birth country	1.399	0.039	0.242	0.007
	(0.942)	(0.026)	(0.188)	(0.006)
Sex	6.184***	0.166***	3.346***	0.097***
	(0.564)	(0.015)	(0.099)	(0.003)
Age	0.370*	0.009*	0.052	0.001
	(0.216)	(0.005)	(0.032)	(0.001)
Age squared	-0.004*	-0.000*	-0.001*	-0.000*
	(0.002)	(0.000)	(0.000)	(0.000)
Constant	26.037***	3.327***	36.633***	3.577***
	(5.247)	(0.133)	(1.810)	(0.050)
N	3023	3023	35744	35744

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Coefficients on dummies for year, county, education level and educational field are not shown

In Table 10, the possibility of serial correlation and heteroskedasticity in the error terms is addressed, as in the ETI estimation. In addition, controls for level and field of education and in which county income is reported are added. These estimates translate to elasticities of 0.084, 0.157, 0.048 and 0.126, for each specification, respectively. The coefficients change to some extent, standard errors increase for all specifications, which leads to that none of the treatment effects are found significant. However, I do not interpret the loss of significance as an inherent failure of the procedure, but rather that it reflects the large heterogeneity in responses to taxation. More data would be necessary to obtain a statistically significant effect with these specifications. Nonetheless, the results indicate that the elasticity of working hours is positive and smaller in magnitude than the ETI. One interpretation of the elasticity of working hours is that it is a lower bound estimate of "real effects" constituting the ETI, as responses contained in the "residual effect" can to some extent also be real.

Baseline estimates between 0.19 and 0.22 for the ETI and between 0.13 and 0.19 for the elasticity of working hours points to the self-employed being responsive to tax changes, and that there is a significant “real” part to ETI. Furthermore, it indicates that the “residual” effect is between 0.03 and 0.06. Some of the responses composing the residual effect may work in opposite directions, which conveys that this is the resulting net residual effect. Interpreting this residual as tax sheltering implies an elasticity of sheltering between -0.06 and -0.03. This suggests that income sheltering is small or that it does not respond much to tax changes, and that the self-employed responded more by changing hours of work than income sheltered.

6. Conclusion

There are multiple possible tax responses for the self-employed. Six responses were explained and surveyed; changes in income, working hours, capital, avoidance and evasion, entry and exit, and organisational shifts. The main emphasis was on the ETI and the elasticity of working hours. Heim's (2010) partitioning of the ETI is used to obtain insight into what constitutes the elasticity. To explore one aspect of the multiple responses to taxation among the self-employed, I compared the ETI to the hours of work elasticity.

By applying quasi-experimental methods to two data sets, the income register data and the Labour Force Survey, estimates of the ETI and the elasticity of working hours were found. A panel data approach and a difference-in-differences method were used for the ETI and the elasticity of working hours estimations respectively. Issues in the panel data analysis were addressed and, by following the earlier literature, controls for mean reversion and trends in income were added.

My findings indicate that the self-employed respond to reduced marginal tax rates by earning more income and working more hours than they would have absent the reform. The effects are however fairly small: ETI estimates between 0.19 and 0.22 are found, depending on the choice of controls, and estimates of the elasticity of working hours are between 0.13 and 0.19 in the main specifications, depending on the same choice of controls. Some main changes to the specifications do not change the sign of the tax sheltering response, although the size differs by the specifications chosen. The small difference between the ETI and the elasticity of working hours means that the remaining effects either are not large or that they work in opposite directions. When the difference is interpreted as an "elasticity of sheltering", it is found to be between - 0.06 and - 0.03 for the main specifications. Hence, this indicates that tax sheltering among the self-employed in Norway was reduced, and that they responded more by changing hours worked than by changing income sheltered when tax levels were reduced by the 2006 tax reform. The small magnitude of the sheltering response points to that little income is sheltered or that the amount of sheltering does not respond much to taxation.

Compared to wage earners, this thesis has provided evidence for that the self-employed respond more, and that the most important explanation of the difference seems to be that the self-employed have larger possibilities to choose their working hours than wage earners have. The response estimates are similar to estimates of the self-employed's tax responsiveness in Denmark. In comparison to the U.S., the estimates found for Norway are smaller, but estimates for "real responses" differ less. This indicates that reporting responses might be a more important part of the

self-employed's response to taxation in the U.S. than in Norway. The reason may be that there are more possibilities for tax exemptions in the U.S. than in Norway.

An important limitation in my strategy is that capital responses are not considered. There is little evidence on this subject for the self-employed, but if capital responses can be significant and are realised in the short term, the sheltering response identified will also include the capital responses of the self-employed. Organisational shifts may also bias the estimate in significant ways. As the 2006 tax reform changed incentives for organisational shifting, a particularly interesting further development would be to control for organisational shifting among the self-employed when measuring the ETI.

The empirical findings indicate that there are low efficiency costs from income taxation of the self-employed in Norway. However, tax responses of the self-employed is an important and still under-researched topic. It is necessary to consider the multiple behavioural margins, as one measure cannot summarize the tax behaviour of individuals, least of all the self-employed. Relations between different margins, especially between the ETI, hours of work, organisational shift and evasion, ought to be investigated further. In that sense, this thesis is a small step to improve information on this group of tax-payers.

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Appendix

A.1 ETI as a Sufficient Statistic

Following the setup in Slemrod and Gillitzer (2014), the ETI as a sufficient statistic will be derived.

The self-employed maximize utility, which in this case is assumed to be quasi-linear

$$\max_{c,h,s} \{u(c,h) = c - f(h)\} \quad s.t. \; c = (1-\tau)wh + \tau s - g(wh,s) + E \tag{A.1}$$

where h is hours of work, f is a convex cost function of efforts, τ is the marginal tax rate, w is the exogenous wage rate, s is income that is sheltered (by legal or illegal means), g is the cost function of this sheltering and E is non-labour income. The model captures the motive for tax avoidance and tax evasion. By undertaking some cost, the self-employed can shelter an amount of income s from taxation, and thus gain the marginal tax rate times the sheltering minus the cost of sheltering. The cost function can include various type of costs related to tax sheltering, including the time used to shelter or the lower pay received by working in the black market. The cost depends both on the amount that is sheltered and the gross income from labour.

Inserting the constraint into the objective function and differentiating with respect to h and s leads to the first order conditions

$$h: (1-\tau)w - wg_1' - wf' = 0 \tag{A.2}$$

$$s: \tau - g_2' = 0\,, \tag{A.3}$$

which implicitly defines the optimal hours worked, $h^*(\tau)$, and the amount sheltered, $s^*(\tau)$. Consumption is then also chosen optimally, $c^*(\tau)$. Obtaining theoretical predictions from comparative statics is not immediately feasible in this framework, as the results will depend on the particulars of the g-function.

Instead of comparative statics, the government is introduced, which will maximize welfare subject to the self-employed's choices of hours, sheltering and consumption. The welfare of the government equals the utility of the agents (the number of agents is now normalized to one) plus the revenue

$$W = c^*(\tau) - f\big(h^*(\tau)\big) + R\,, \tag{A.4}$$

where R is the tax revenue

$$R = \tau\big(wh(\tau) - s(\tau)\big) = \tau z(\tau) \tag{A.5}$$

and z is defined as taxable income

$$z = wh - s\,. \tag{A.6}$$

Hence

$$W = (1-\tau)wh^*(\tau) + \tau s^*(\tau) - g\big(wh^*(\tau), s^*(\tau)\big) + E - f\big(h^*(\tau)\big) + \tau z(\tau)\,. \tag{A.7}$$

Now, to maximize welfare, the government will use their only instrument, τ. The agents have maximized their utility, which means that c, h and s are at their optimal value for a given τ. This imply that any small change in the marginal tax rate will not change the optimal behaviour of the agent, so the effect of the change in the marginal tax rate on labour supply and sheltering need not be considered. Therefore, the only effect of changing τ will, by the envelope theorem, be the effect on tax revenue

$$\frac{\partial W}{\partial \tau} = -wh + s + z + \tau\frac{\partial z}{\partial \tau} = -wh + s + wh - s + \tau\frac{\partial z}{\partial \tau} = \tau\frac{\partial z}{\partial \tau}\,. \tag{A.8}$$

The change in welfare is exactly the ETI, and the intuition is that as the agent has maximized, there will only be a first order effect of changing the marginal tax rate. This shows why the ETI has the potential for being a sufficient statistic.

A.2 Model of the System

An equivalent way of explaining the role of the instrument and exogenous trends in income is to model the system:

$$\ln\left(\frac{I_{i,t}}{I_{i,t-3}}\right) = \beta \ln\left(\frac{1-\tau_{i,t}}{1-\tau_{i,t-3}}\right) + \rho \ln\left(I_{i,t-3}\right) + \epsilon_{1i,t} \tag{A.9}$$

$$\ln\left(\frac{1-\tau_{i,t}}{1-\tau_{i,t-3}}\right) = \kappa \ln\left(\frac{I_{i,t}}{I_{i,t-3}}\right) + \iota \ln\left(\frac{1-\tau_{i,t}^{I}}{1-\tau_{i,t-3}}\right) + \epsilon_{2i,t}\,, \tag{A.10}$$

where the first equation is the equation for changes in income, which is the equation of interest. The changes in income depend here on the changes in the actual marginal tax rates and on base year income. The second equation is an equation for changes in the tax rate, which here is modelled to depend on changes in income and on reform induced changes in the marginal tax rate.

There is a simultaneity problem, as the changes in income are affected by the changes in the marginal tax rate, while the changes in marginal tax rate are also affected by the changes in income. The changes in the marginal tax rate are in addition affected by the changes in the marginal tax rate that is only due to the reform. This can be used as an instrument in the equation for income, as long as the tax changes due to the reform do not have any direct effect on the changes in income, but only through the actual changes in the marginal tax rates, which seems fairly plausible. This is because the self-employed will react to marginal tax rates that actually apply to them, and not to the marginal tax rates that would have been, had income not changed. The changes in the actual marginal tax rates will however be correlated with the marginal tax rates that would have been without changes in income, as the reform will affect the actual marginal tax rates. As the instrument induces exogenous variation in the equation for tax changes, the equation for income changes will be identified.

Furthermore, the instrument needs to be uncorrelated with the error term in the income equation. This will hold if the changes in the marginal tax rates that are only due to the reform, are uncorrelated with shocks to income. For this to hold there needs to be no simultaneous changes in income that are not due to the tax reform. By introducing that the change in income also depends on itself lagged, this rather strong assumption can be somewhat relaxed. Now, with lagged income on the right hand side in the income equation, the instrument needs only be uncorrelated with changes in income that are not induced by the tax reform or can be explained by the base year income level.

The dependence of the change in income on income lagged can be explained either by a trend in inequality not induced by the tax reform, or by mean reversion, that both the high and low earners are more likely to be closer to the mean next year. If the high earners have larger changes in income through a trend towards inequality, then ρ will be positive, while if mean reversion is important, ρ will be negative, as there are exogenous negative changes in income for the high earners not induced by the changes in tax rates.

A.3 Sensitivity Analysis

A.3.1 Elasticity of taxable income

Table 11: *ETI excluding all with income from wages higher than business income for all years*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
ETI	-2.815***	-0.946***	0.101***	0.141***	0.153***
	(0.010)	(0.015)	(0.020)	(0.021)	(0.021)
Age	-0.004***	-0.008***	0.000	0.000	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	0.000***	0.000***	-0.000***	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.007***	0.001	0.037***	0.039***	0.031***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Birth country	-0.000	0.005*	-0.010**	-0.007**	-0.002
	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)
Children	0.013***	0.018***	0.026***	0.022***	0.025***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Married	0.005***	0.005***	0.012***	0.012***	0.012***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
N	369817	369809	369809	369809	317068

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies, lagged dependent variables and splines are not shown

Table 12: *ETI excluding primary sector*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
ETI	-3.037***	-1.056***	-0.012	0.124***	0.147***
	(0.010)	(0.015)	(0.020)	(0.021)	(0.021)
Age	-0.003***	-0.009***	0.003***	0.003***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	0.000	0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.008***	-0.005***	0.045***	0.050***	0.038***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Birth country	0.000	-0.003	0.007**	0.011***	0.010***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Children	0.014***	0.014***	0.041***	0.039***	0.035***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Married	0.008***	0.007***	0.026***	0.026***	0.023***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
N	394258	394233	394233	394233	337220

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies, lagged dependent variables and splines are not shown

Table 13: *ETI excluding low reported income*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
ETI	-2.827***	-0.931***	0.018	0.184***	0.189***
	(0.009)	(0.013)	(0.017)	(0.019)	(0.018)
Age	-0.002***	-0.006***	0.003***	0.003***	0.000
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	-0.000	0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.008***	-0.001	0.034***	0.039***	0.032***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Birth country	-0.009***	-0.004	-0.027***	-0.025***	-0.016***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)
Children	0.011***	0.015***	0.025***	0.022***	0.024***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Married	0.006***	0.007***	0.015***	0.015***	0.015***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
N	446389	446389	446389	446389	382407

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies, lagged dependent variables and splines are not shown

Table 14: *ETI with business income as dependent variable*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
ETI	-2.803***	-0.911***	0.759***	0.443***	0.164***
	(0.015)	(0.024)	(0.028)	(0.027)	(0.027)
Age	0.011***	0.007***	0.039***	0.039***	0.040***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	-0.000***	-0.000***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.001	-0.006**	0.079***	0.065***	0.043***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Birth country	-0.037***	-0.032***	-0.040***	-0.034***	-0.026***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Children	0.004	0.008***	0.027***	0.021***	0.024***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Married	0.011***	0.012***	0.036***	0.035***	0.028***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
N	527730	527705	527703	527703	444215

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies, lagged dependent variables and splines are not shown

Table 15: *ETI for all with business income nonzero and non-missing for all years and higher business than wage earnings around the reform*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
ETI	-2.897***	-0.997***	0.110***	0.165***	0.173***
	(0.010)	(0.015)	(0.019)	(0.021)	(0.020)
Age	-0.005***	-0.009***	-0.001	-0.001	-0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	0.000***	0.000***	-0.000***	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.003***	-0.003**	0.033***	0.035***	0.027***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Birth country	-0.003	0.003	-0.020***	-0.018***	-0.011***
	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)
Children	0.010***	0.014***	0.020***	0.017***	0.018***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Married	0.003**	0.003**	0.012***	0.012***	0.011***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
N	423000	422987	422987	422987	363204

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies, lagged dependent variables and splines are not shown

Table 16: *ETI for all with business income nonzero and non-missing for all years*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
ETI	-2.665***	-0.903***	0.046***	0.077***	0.077***
	(0.008)	(0.010)	(0.013)	(0.013)	(0.013)
Age	-0.003***	-0.007***	0.004***	0.005***	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Age squared	0.000***	0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.003***	-0.008***	0.040***	0.040***	0.030***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Birth country	-0.003	0.002	-0.021***	-0.015***	-0.010***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Children	0.011***	0.014***	0.020***	0.018***	0.019***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Married	0.003***	0.002**	0.012***	0.013***	0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N	769124	769094	769094	769094	660476

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies, lagged dependent variables and splines are not shown

Table 17: *ETI on the labour force survey-data*

	(1) ORD	(2) IV	(3) IV: Baseyear	(4) IV: Gruber Saez	(5) IV: Kopczuk
ETI	-2.858***	-0.986***	0.090	0.097	0.225**
	(0.048)	(0.069)	(0.090)	(0.092)	(0.094)
Age	-0.009***	-0.012***	-0.008**	-0.009**	-0.014***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Age squared	0.000***	0.000***	0.000	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sex	0.003	-0.001	0.032***	0.036***	0.030***
	(0.006)	(0.007)	(0.010)	(0.010)	(0.010)
Birth country	-0.001	0.011	-0.025	-0.023	-0.009
	(0.013)	(0.014)	(0.020)	(0.018)	(0.020)
Children	0.007	0.008	0.023**	0.020**	0.016
	(0.007)	(0.008)	(0.010)	(0.009)	(0.011)
Married	0.002	0.001	0.007	0.009	0.010
	(0.007)	(0.008)	(0.009)	(0.009)	(0.011)
N	17067	17067	17067	17067	14616

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies, lagged dependent variables and splines are not shown

A.3.2 Elasticity of working hours

Figure 8: *Change from last year's difference in hours worked between treatment and control group (wage earners included)*

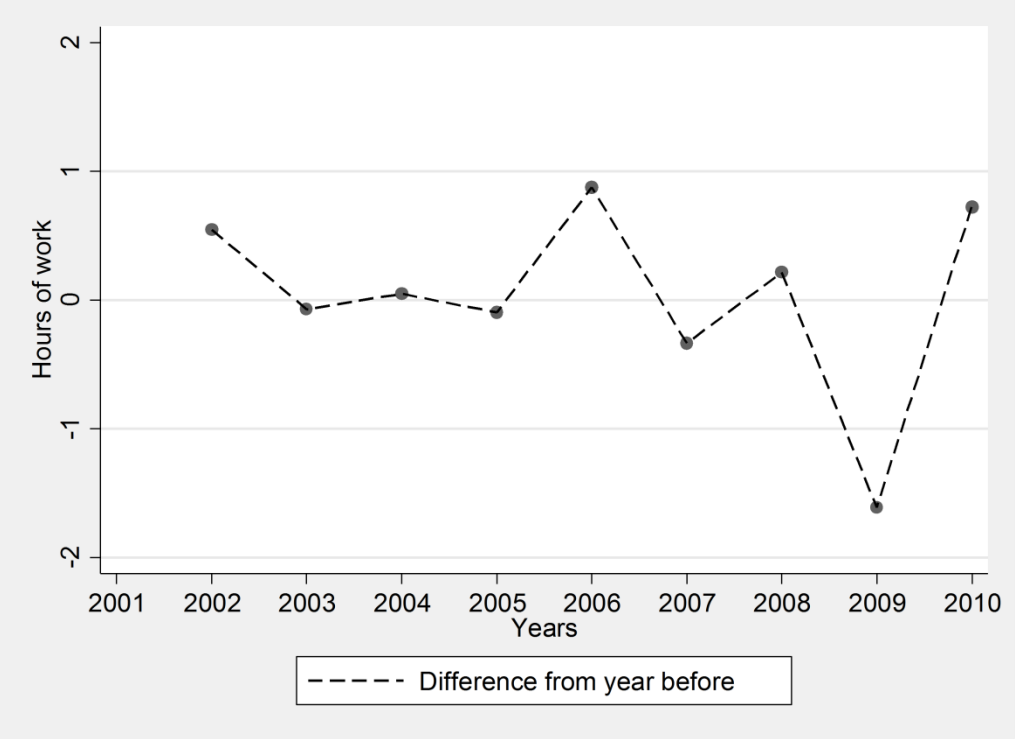

Figure 9: *Change from last year's difference in hours worked between treatment and control group (self-employed only)*

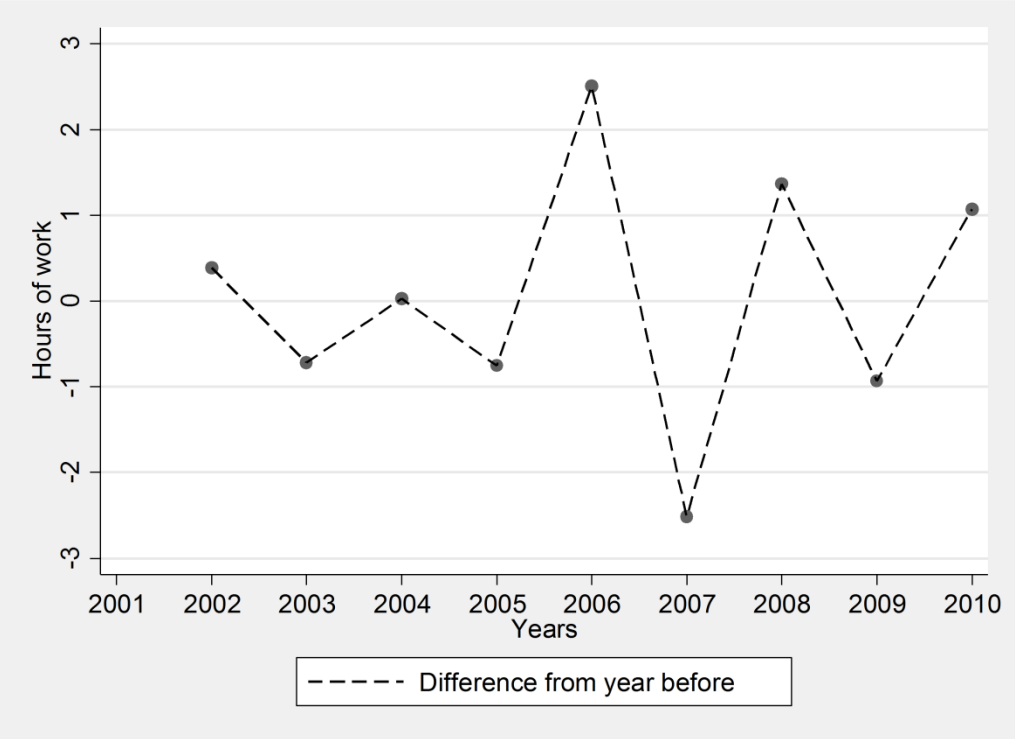

Table 18: *Elasticity of working hours for all with business income higher than zero for 2004-2006*

	(1) Level	(2) Log	(3) Level – large control	(4) Log – large control
Tax treatment	0.053	0.005	0.265*	0.012***
	(0.423)	(0.011)	(0.156)	(0.005)
Treated	0.645**	0.020**	3.188***	0.074***
	(0.304)	(0.008)	(0.112)	(0.003)
Children	-0.557**	-0.015**	-0.517***	-0.016***
	(0.262)	(0.007)	(0.069)	(0.002)
Married	-0.208	-0.006	-0.561***	-0.016***
	(0.254)	(0.007)	(0.065)	(0.002)
Birth country	1.928***	0.053***	0.120	0.003
	(0.473)	(0.013)	(0.124)	(0.004)
Sex	5.645***	0.155***	3.811***	0.112***
	(0.252)	(0.007)	(0.060)	(0.002)
Age	0.333***	0.010***	0.138***	0.004***
	(0.101)	(0.003)	(0.022)	(0.001)
Age squared	-0.004***	-0.000***	-0.002***	-0.000***
	(0.001)	(0.000)	(0.000)	(0.000)
Constant	26.805***	3.290***	31.943***	3.446***
	(2.405)	(0.064)	(0.493)	(0.015)
N	7285	7285	53400	53400

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies are not shown

Elasticities: 0.03, 0.10, 0.14, 0.21

Table 19: *Elasticity of working hours excluding primary sector*

	(1) Level	(2) Log	(3) Level – large control	(4) Log – large control
Tax treatment	0.435	0.020	0.398*	0.017**
	(0.741)	(0.020)	(0.240)	(0.007)
Treated	0.987*	0.022	4.193***	0.098***
	(0.543)	(0.015)	(0.169)	(0.005)
Children	-1.129***	-0.029***	-0.601***	-0.018***
	(0.404)	(0.011)	(0.069)	(0.002)
Married	-0.116	-0.001	-0.556***	-0.016***
	(0.393)	(0.011)	(0.065)	(0.002)
Birth country	2.212***	0.063***	0.003	-0.000
	(0.607)	(0.016)	(0.123)	(0.004)
Sex	4.487***	0.122***	3.481***	0.104***
	(0.383)	(0.010)	(0.060)	(0.002)
Age	0.677***	0.019***	0.111***	0.004***
	(0.161)	(0.004)	(0.022)	(0.001)
Age squared	-0.007***	-0.000***	-0.002***	-0.000***
	(0.002)	(0.000)	(0.000)	(0.000)
Constant	20.236***	3.113***	32.852***	3.468***
	(3.850)	(0.104)	(0.494)	(0.015)
N	2706	2706	46562	46562

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies are not shown

Elasticities: 0.21, 0.37, 0.18, 0.27

Table 20: *Elasticity of working hours with income controls*

	(1) Level	(2) Log	(3) Level – large control	(4) Log – large control
Tax treatment	0.585	0.018	0.128	0.010
	(0.796)	(0.021)	(0.293)	(0.009)
Treated	-1.444**	-0.037**	3.453***	0.064***
	(0.712)	(0.019)	(0.256)	(0.008)
Children	-1.049**	-0.029**	-0.552***	-0.017***
	(0.445)	(0.012)	(0.086)	(0.003)
Married	0.174	0.005	-0.529***	-0.016***
	(0.431)	(0.011)	(0.080)	(0.002)
Birth country	2.847***	0.077***	0.028	-0.001
	(0.721)	(0.019)	(0.150)	(0.004)
Sex	6.254***	0.166***	3.676***	0.107***
	(0.429)	(0.011)	(0.074)	(0.002)
Age	0.597***	0.016***	0.115***	0.004***
	(0.187)	(0.005)	(0.029)	(0.001)
Age squared	-0.007***	-0.000***	-0.002***	-0.000***
	(0.002)	(0.000)	(0.000)	(0.000)
Lagged income	0.370	0.015	2.846***	0.097***
	(0.364)	(0.010)	(0.137)	(0.004)
Constant	17.301***	3.001***	-2.979*	2.257***
	(6.207)	(0.162)	(1.754)	(0.053)
N	2763	2763	34595	34595

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies are not shown

Elasticities: 0.30, 0.38, 0.06, 0.16

Table 21: *Elasticity of working hours exluding large changes in hours*

	(1) Level	(2) Log	(3) Level – large control	(4) Log – large control
Tax treatment	0.030	0.003	0.225	0.011*
	(0.606)	(0.016)	(0.224)	(0.007)
Treated	-0.683	-0.015	4.646***	0.108***
	(0.439)	(0.011)	(0.160)	(0.005)
Children	-0.689*	-0.018*	-0.494***	-0.015***
	(0.366)	(0.009)	(0.069)	(0.002)
Married	0.188	0.006	-0.530***	-0.016***
	(0.354)	(0.009)	(0.065)	(0.002)
Birth country	2.972***	0.078***	0.159	0.004
	(0.612)	(0.016)	(0.124)	(0.004)
Sex	6.026***	0.157***	3.766***	0.111***
	(0.361)	(0.009)	(0.060)	(0.002)
Age	0.508***	0.013***	0.124***	0.004***
	(0.141)	(0.004)	(0.022)	(0.001)
Age squared	-0.006***	-0.000***	-0.002***	-0.000***
	(0.001)	(0.000)	(0.000)	(0.000)
Constant	24.882***	3.260***	32.190***	3.456***
	(3.379)	(0.087)	(0.493)	(0.015)
N	3680	3680	48254	48254

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Coefficients on year dummies are not shown

Elasticities: 0.02, 0.07, 0.11, 0.19